WATER - RESOURCES REPORT NUMBER THIRTY - FIVE
ARIZONA STATE LAND DEPARTMENT
OBED M. LASSEN, COMMISSIONER

GROUND WATER IN PARADISE VALLEY MARICOPA COUNTY, ARIZONA

BY F. E. ARTEAGA, NATALIE D. WHITE
M. E. COOLEY, AND A. F. SUTHEIMER

ARED BY THE GEOLOGICAL SURVEY
TED STATES DEPARTMENT OF THE INTERIOR
COOPERATION WITH THE CITY OF SCOTTSDALE

PHOENIX, ARIZONA
MAY 1968

ARIZONA STATE LAND DEPARTMENT WATER-RESOURCES REPORTS

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No.

* 1. Pumpage and ground-water levels in Arizona in 1955, by P. W. Johnson, N. D. White, and J. M. Cahill: 69 p., 30 figs., 1956.

* 2. Annual report on ground water in Arizona, spring 1956 to spring 1957, by J. W. Harshbarger and others: 42 p., 18 figs., 1957.

* 3. Geology and ground-water resources of the Harquahala Plains area, Maricopa and Yuma Counties, Arizona, by D. G. Metzger: 40 p., 2 pls., 7 figs., 1957.

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* 5. Annual report on ground water in Arizona, spring 1957 to spring 1958, by W. F. Hardt, J. M. Cahill, and M. B. Booher: 60 p., 19 figs., 1958.

* 6. Annual report on ground water in Arizona, spring 1958 to spring 1959, by W. F. Hardt, R. S. Stulik, and M. B. Booher: 61 p., 18 figs., 1959.

* 7. Annual report on ground water in Arizona, spring 1959 to spring 1960, by W. F. Hardt, R. S. Stulik, and M. B. Booher: 89 p., 22 figs., 1960.

* 8. Geology and ground-water resources of the McMullen Valley, Maricopa, Yavapai, and Yuma Counties, Arizona, by William Kam: 72 p., 17 figs., 1961.

9. Hydrologic data and drillers' logs, Papago Indian Reservation, Arizona, by L. A. Heindl and O. J. Cosner, with a section on chemical quality of the water by L. R. Kister: 116 p., 3 figs., 1961.

*10. Annual report on ground water in Arizona, spring 1960 to spring 1961, by N. D. White, R. S. Stulik, E. K. Morse, and others: 93 p., 32 figs., 1961.

*11. Annual report on ground water in Arizona, spring 1961 to spring 1962, by N. D. White, R. S. Stulik, and others: 116 p., 35 figs., 1962.

No.

*12A. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I, Records of ground-water supplies, by G. E. Davis, W. F. Hardt, L. K. Thompson, and M. E. Cooley: 159 p., 3 figs., 1963.

*12B. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part II, Selected chemical analyses of the ground water, by L. R. Kister and J. L. Hatchett: 58 p., 2 figs., 1963.

12C. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part III, Selected lithologic logs, drillers' logs, and stratigraphic sections, by M. E. Cooley, J. P. Akers, and P. R. Stevens: 157 p., 3 figs., 1964.

12D. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part IV, Maps showing locations of wells, springs, and stratigraphic sections, by M. E. Cooley and others: 2 sheets, 1966.

12E. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I-A, Supplemental records of ground-water supplies, by E. H. McGavock, R. J. Edmonds, E. L. Gillespie, and P. C. Halpenny: 55 p., 4 figs., 1966.

13. Desert floods—a report on southern Arizona floods of September 1962, by D. D. Lewis: 13 p., 18 figs., 1963.

*14. Basic ground-water data of the Willcox basin, Graham and Cochise Counties, Arizona, by S. G. Brown, H. H. Schumann, L. R. Kister, and P. W. Johnson: 93 p., 15 figs., 1963.

*15. Annual report on ground water in Arizona, spring 1962 to spring 1963, by N. D. White, R. S. Stulik, E. K. Morse, and others: 136 p., 47 figs., 1963.

16. Effects of ground-water withdrawal in part of central Arizona projected to 1969, by N. D. White, R. S. Stulik, and C. L. Rauh: 25 p., 7 figs., 1964.

(Continued on inside back cover)

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This report has been designated as a Water-Resources Report of the Arizona State Land Department by permission of Obed M. Lassen, State Land Commissioner. The State Land Department has not participated in any way, either in the collection and compilation of the data or in the preparation and duplicating of this report.

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GROUND WATER IN PARADISE VALLEY,
MARICOPA COUNTY, ARIZONA

By

F. E. Arteaga, Natalie D. White,
M. E. Cooley, and A. F. Sutheimer

ABSTRACT

The purpose of this study was to update knowledge of the ground-water conditions in Paradise Valley. The investigation, begun in July 1966, was conducted by the U.S. Geological Survey in cooperation with the city of Scottsdale and was under the immediate supervision of H. M. Babcock, district chief of the Water Resources Division in Arizona.

A large part of Paradise Valley is underlain by more than 1,500 feet of water-yielding alluvial deposits—divided informally into the lower alluvium, the middle alluvium, and the upper alluvium. In places the alluvial deposits overlie the red unit, which is composed of conglomerate to siltstone.

Analysis of yield-drawdown data for individual wells indicates that in southern Paradise Valley the upper alluvium, lower alluvium, and red unit are more permeable and yield more water to wells than the middle alluvium. In most of northern and central Paradise Valley wells do not penetrate as great a thickness of the lower alluvium and are not as productive.

For the most part, the quality of the water from wells in Paradise Valley is suitable for municipal, irrigation, and domestic uses. The water from some wells in the southern part of the valley, however, contains more than the recommended amount of dissolved solids for domestic use, and in nearly all the area the water is considered hard.

From 1946 through 1965, slightly less than 1.4 million acre-feet of ground water was withdrawn from the aquifer system in Paradise Valley. A large part of the ground-water withdrawal has been in the southern part of the valley, where nearly 1, 280, 000 acre-feet of ground water

was withdrawn from 1946 through 1965; water-level declines during this period ranged from about 75 feet at the north edge of the area to more than 225 feet near Scottsdale. In northern and central Paradise Valley the development of ground water and the resulting water-level declines have been less.

INTRODUCTION

The availability of adequate water supplies is often the determining factor in the economic growth of an area, particularly in arid or semiarid regions. In much of Arizona, the ground-water reservoirs are the main source of water. Thus, a thorough knowledge of the factors related to the occurrence and use of ground water is of prime importance in long-range planning and development.

The investigation of ground-water conditions in Paradise Valley (fig. 1), begun in July 1966, was conducted by the U. S. Geological Survey in cooperation with the city of Scottsdale and was under the immediate supervision of H. M. Babcock, district chief of the Water Resources Division in Arizona. Paradise Valley, once an area of undeveloped desert with a few farms and citrus orchards, is now part of the rapidly expanding metropolitan area that surrounds the city of Phoenix. Scottsdale is at the south end of Paradise Valley and is the largest community in the valley. The population of Scottsdale has increased from about 10,000 in 1960 to 54, 500 in 1965. The town of Paradise Valley, near the center of the area, had a population of about 4,650 in 1965, whereas the population was less than 2,100 in 1960. This population expansion has been accompanied by a growing need for water.

Conditions—in relation to the pattern of ground-water development, the effects of ground-water withdrawal, current depths to water, and, to some extent, the hydrologic characteristics of the aquifer system—differ in various parts of the valley. Therefore, the valley has been divided into three parts in this report—the northern, central, and southern parts (fig. 2).

Purpose and Scope of the Study

The purpose of this study was to update knowledge of the ground-water conditions in Paradise Valley. This was accomplished by (1) collecting and studying current basic data and comparing these data and

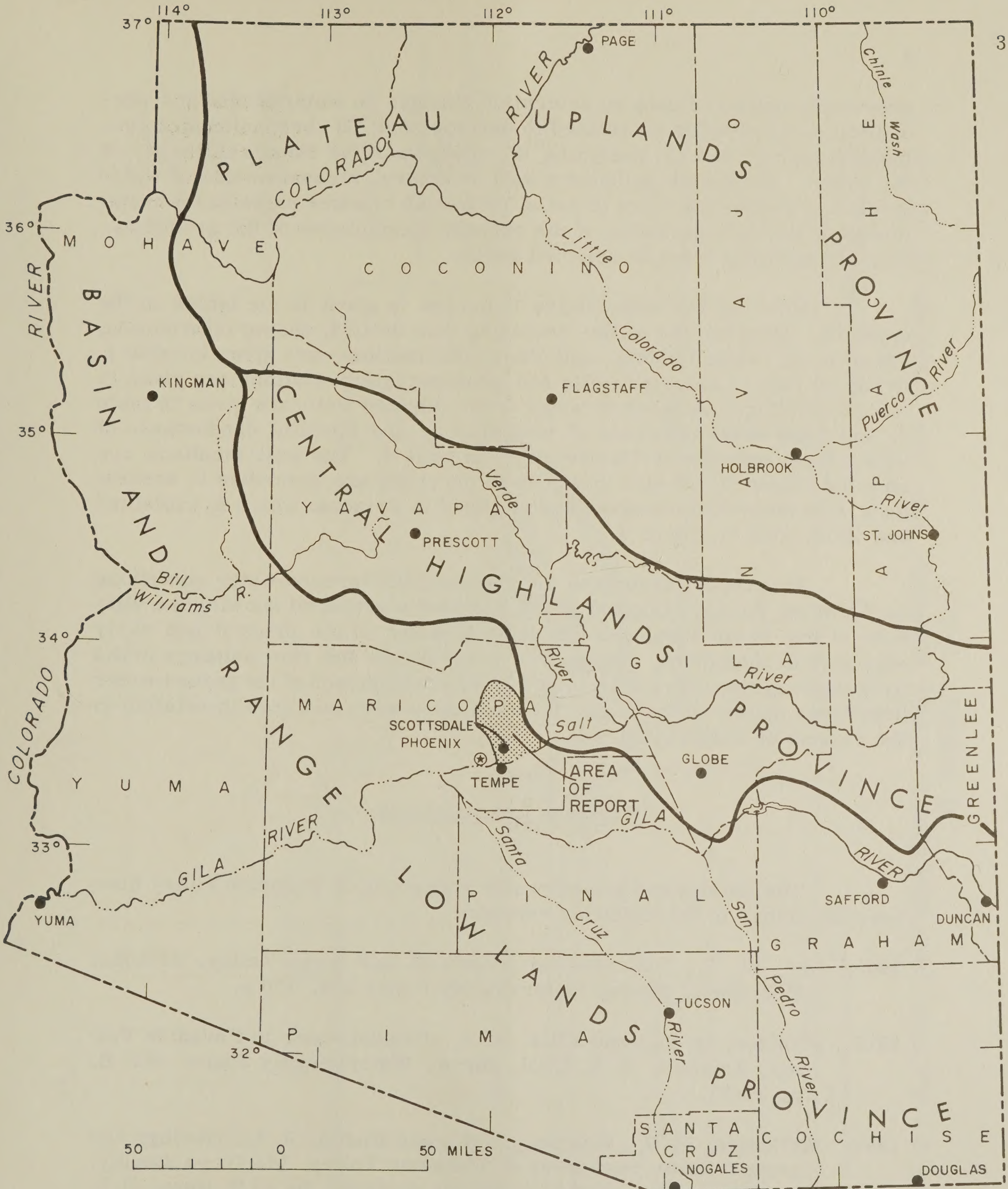


FIGURE 1.--AREA OF REPORT AND ARIZONA'S WATER PROVINCES.

previously collected data to determine changes in water levels and production rates of wells as related to development; (2) reconnaissance geologic mapping; and (3) analyzing the changes in the chemical quality of the water. Fieldwork included a well inventory, measurements of water levels and production rates of wells, collection of water samples for chemical analysis, determination of the specific conductance of the ground water, and pumping tests at selected wells.

Much of the information collected is given in the tables in the appendix. Data for the wells—including date drilled, casing information, water level, pumping data, and other information—are given in table 1. Drillers' logs of selected wells and geologic interpretations are given in table 2; chemical analyses of water from selected wells are given in table 3, and field determinations of temperature and specific conductance of water from selected wells are given in table 4. The well locations are shown on figure 2; all well locations in the valley are described in accordance with the well-numbering system used in Arizona, which is explained and illustrated on figure 3.

This report describes the present (1966) ground-water conditions in Paradise Valley. Contour maps have been prepared showing the altitude of the water level and the depth to water at the present and early stages of development. Changes in water levels and flow patterns in the hydrologic system were determined from a comparison of the ground-water conditions shown on the maps; these changes were analyzed in relation to the volume of water withdrawn.

Previous Investigations

The geology and ground-water resources of Paradise Valley have been described in the following reports:

1905. Lee, W. T., Underground waters of Salt River Valley, Arizona: U. S. Geol. Survey Water-Supply Paper 136, 196 p.

1915. Meinzer, O. E., and Ellis, A. J., Ground water in Paradise Valley, Arizona: U. S. Geol. Survey Water-Supply Paper 375-B, p. 51-75.

1947. McDonald, H. R., Wolcott, H. N., and Bluhm, F. I., Geology and ground-water resources of Paradise Valley, Maricopa County, Arizona, with a section on quality of water, by J. D. Hem: U. S. Geol. Survey open-file report, 34 p.

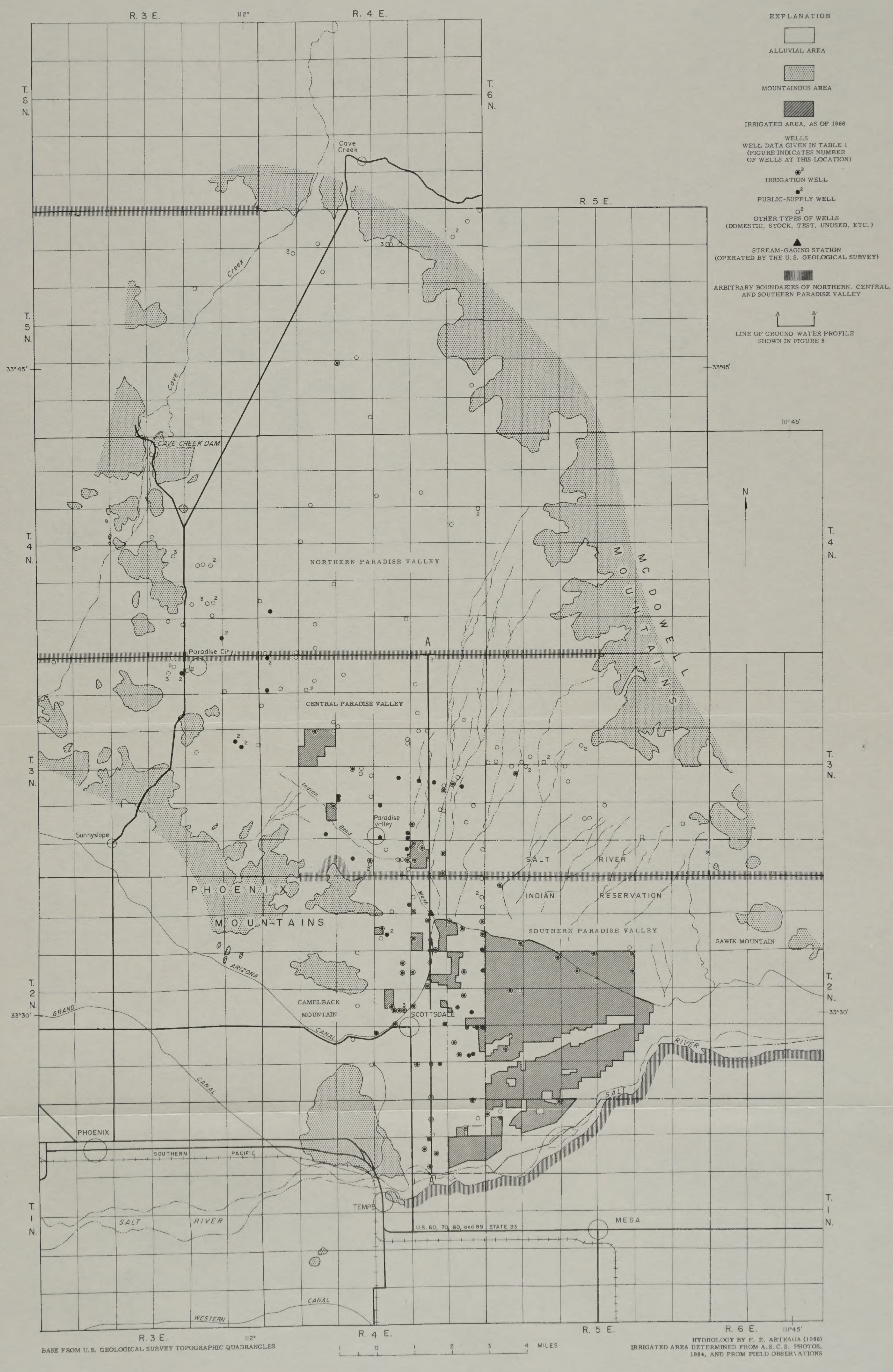
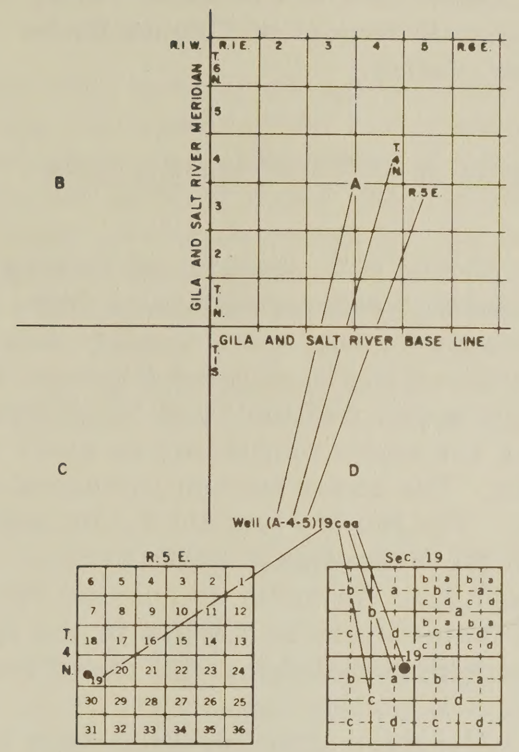


FIGURE 2.--ALLUVIAL AND MOUNTAINOUS AREAS, IRRIGATED AREA, AND LOCATION OF WELLS IN PARADISE VALLEY.



The well numbers used by the Geological Survey in Arizona are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the State into four quadrants. These quadrants are designated counterclockwise by the capital letters A, B, C, and D. All land north and east of the point of origin is in A quadrant, that north and west in B quadrant, that south and west in C quadrant, and that south and east in D quadrant. The first digit of a well number indicates the township, the second the range, and the third the section in which the well is situated. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. These letters also are assigned in a counterclockwise direction, beginning in the northeast quarter. If the location is known within the 10-acre tract, three lowercase letters are shown in the well number. In the example shown, well number (A-4-5)19caa designates the well as being in the NE$\frac{1}{4}$NE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 19, T. 4 N., R. 5 E. Where there is more than one well within a 10-acre tract, consecutive numbers beginning with 1 are added as suffixes.

FIGURE 3.--WELL-NUMBERING SYSTEM IN ARIZONA.

Ground-water conditions in Paradise Valley also have been discussed briefly in the "Annual Report on Ground Water in Arizona," in the section on the Salt River Valley.

Reporting of Water-Quality Data

The Director of the U. S. Geological Survey has approved the change in reporting of Survey water-quality data from the English system to metric system. Therefore, the water-quality data in this report are given in milligrams per liter (mg/l), degrees Celsius (°C), and micromhos at 25°C. The terms "parts per million" and "milligrams per liter" are practically synonymous for water containing as much as 5, 000 to 10, 000 mg/l of dissolved solids. The exact amount is dependent on the nature of the dissolved material. The Survey has set 7, 000 mg/l dissolved solids as the point above which the difference in parts per million and milligrams per liter becomes significant. In order to convert data from one system to the other, a density factor must be applied to the analytical results of all water containing more than 7, 000 mg/l of dissolved solids.

Temperature data given in tables 3 and 4 can be converted to degrees Fahrenheit (°F) by using the following:

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
32	0	51	11	70	21	89	32	108	42
33	1	52	11	71	22	90	32	109	43
34	1	53	12	72	22	91	33	110	43
35	2	54	12	73	23	92	33	111	44
36	2	55	13	74	23	93	34	112	44
37	3	56	13	75	24	94	34	113	45
38	3	57	14	76	24	95	35	114	46
39	4	58	14	77	25	96	36	115	46
40	4	59	15	78	26	97	36	116	47
41	5	60	16	79	26	98	37	117	47
42	6	61	16	80	27	99	37	118	48
43	6	62	17	81	27	100	38	119	48
44	7	63	17	82	28	101	38	120	49
45	7	64	18	83	28	102	39	121	49
46	8	65	18	84	29	103	39	122	50
47	8	66	19	85	29	104	40		
48	9	67	19	86	30	105	41		
49	9	68	20	87	31	106	41		
50	10	69	21	88	31	107	42		

Acknowledgments

The authors wish to acknowledge the cooperation of the following individuals and firms who were helpful in furnishing information for this study: Officials and employees of the cities of Scottsdale and Phoenix and of Maricopa County; the several water companies serving the area; the Salt River Valley Water Users' Association; the Arizona Public Service Co.; and the Salt River Indian Agency. In addition, many residents, well drillers, and pump companies have furnished information regarding wells in the valley. Reports prepared by H. J. Thiele (1961; 1965) and S. F. Turner (1959)—consulting hydrologist and geologist, respectively—that give data concerning the water resources of the valley were available for use by the authors.

PHYSICAL ENVIRONMENT

Paradise Valley is a northwest-trending alluvial-filled trough lying mainly between the Phoenix and McDowell Mountains in Maricopa County in the Basin and Range lowlands (fig. 1). Much of the trough is filled by alluvial deposits, which are divided into three stratigraphic units—lower alluvium, middle alluvium, and upper alluvium (fig. 4). The alluvium is more than 1,500 feet thick in most of the valley. Below the alluvium are red sandstone, conglomerate, and siltstone—referred to collectively in this report as the red unit. The red unit includes rocks that crop out on the Papago Buttes, on Tempe Butte, and near Sawik Mountain. Similar red and reddish-brown rocks underlie the alluvium in much of the trough.

The northern boundary of the valley is along buttelike hills south of the town of Cave Creek and near the north edge of T. 5 N. On the south, Paradise Valley is open and merges with the wide flood plain of the Salt River. On the northeast and east, the valley is bounded by the McDowell Mountains and on the southwest and west by the Phoenix Mountains and other nearby mountains and buttes. The Phoenix Mountains, Camelback Mountain, Papago Buttes, and Tempe Butte are part of a large generally north-trending ridge that is partly buried by the alluvial deposits (fig. 4). The McDowell Mountains are the largest highlands in the area and have a maximum altitude of 4,034 feet above mean sea level; the maximum altitude of the Phoenix Mountains is about 2, 700 feet above mean sea level.

The valley floor is a fairly smooth alluvial plain covering about 250 square miles; it slopes gently southward from an altitude of about

2,000 feet above mean sea level at the base of the hills near Cave Creek to about 1,180 feet at the Salt River. The gradient of the land surface in the central and southern parts of the valley is about 30 feet per mile, but at the north end and along the McDowell Mountains gradients are more than 100 feet per mile. The valley is asymmetrical, and the axis extends northwestward along the southwest side.

All the streams draining Paradise Valley are ephemeral. Cave Creek, the largest stream in the valley, flows southward to southwestward across only the northwest corner of the area and contributes some recharge to the ground-water reservoir. Cave Creek drains about 225 square miles of the mountainous country north of Paradise Valley. Streams heading in the McDowell Mountains extend for much greater distances into the valley than those originating in the Phoenix Mountains.

The climate of Paradise Valley is semiarid, characterized by hot summers and mild winters. The average maximum and minimum temperatures at Tempe in the south end of the valley range from about 103°F in July to about 35°F in January; mean monthly precipitation ranges from about 0.10 inch in June to about 1.20 inches in August, and the mean annual precipitation is 7.58 inches.

More than two-thirds of the average annual precipitation occurs in two seasons—summer and winter. Generally, the summer precipitation occurs as intense thundershowers of short duration; winter rains are more gentle and of longer duration. At times the rains cause floods in the small streams in the valley; these floods, which occur infrequently and are of short duration, may provide recharge to the aquifer system in parts of the valley, but data are insufficient to determine the amount.

GROUND-WATER SYSTEM

General Description

The occurrence of ground water in Paradise Valley is similar to that in many alluvial-filled valleys of the Basin and Range lowlands province. Reconnaissance geologic mapping (fig. 4) and study of the drillers' logs (table 2) indicate that a large part of the valley is underlain by more than 1,500 feet of water-yielding alluvial deposits. The alluvium is divided informally into the lower alluvium, the middle alluvium, and the upper alluvium. In parts of the valley the alluvial deposits overlie rocks of the red unit composed of sandstone, conglomerate, and siltstone. The red unit

EXPLANATION

QTa

UPPER AND MIDDLE ALLUVIUM

INCLUDES FLOOD-PLAIN DEPOSITS, DEPOSITS FORMING TERRACES AND PEDIMENTS, AND DISSECTED ALLUVIAL FANS ALONG THE PHOENIX AND MCDOWELL MOUNTAINS. IN THE CENTRAL PART OF PARADISE VALLEY, THE MIDDLE ALLUVIUM CONSISTS MAINLY OF WEAKLY CEMENTED SILT TO SILTY SAND AND GRAVEL THAT BECOMES MORE GRAVELLY ALONG THE FLANKS OF THE MOUNTAINS. THE DEPOSIT IS CEMENTED BY CALCIUM CARBONATE, AND CONSIDERABLE CALICHE IS PRESENT NEAR THE MOUNTAIN FRONTS. THE MIDDLE ALLUVIUM IS CORRELATED WITH DEPOSITS REFERRED TO AS BASIN FILL BY DAVIDSON (1961) AND COOLEY AND DAVIDSON (1963). LOCALLY, THE DEPOSIT IS MORE THAN 1, 000 FEET THICK. GENERALLY, THE MIDDLE ALLUVIUM IS THE LEAST PRODUCTIVE OF THE WATER-YIELDING DEPOSITS IN PARADISE VALLEY, AND IN THE SOUTHERN PART OF THE VALLEY IT MAY FORM A SEMICONFINING LAYER TO THE GROUND WATER IN THE UNDERLYING COARSE-GRAINED ROCKS. GENERALLY, THE UPPER ALLUVIUM IS WEAKLY CEMENTED, BUT LOCALLY, ESPECIALLY NEAR THE PHOENIX AND MCDOWELL MOUNTAINS, IT IS FIRMLY CEMENTED BY CALICHE. THE UPPER ALLUVIUM INCLUDES GRAVELLY FLOOD-PLAIN DEPOSITS THAT ARE RECOGNIZED ONLY NEAR THE SALT RIVER AND CAVE CREEK. THIS DEPOSIT HAS A MAXIMUM THICKNESS OF ABOUT 250 FEET NEAR THE SALT RIVER AND YIELDS LARGE AMOUNTS OF GROUND WATER EXCEPT WHERE IT HAS BEEN DEWATERED (NEAR SCOTTSDALE) BECAUSE OF THE DECLINE IN THE WATER TABLE

UNCONFORMITY

Tay
Tao

LOWER ALLUVIUM

CONSISTS OF YOUNGER LOWER ALLUVIUM (Tay) AND OLDER LOWER ALLUVIUM (Tao). THE LOWER ALLUVIUM IS CHIEFLY WEAKLY TO MODERATELY CEMENTED SAND AND GRAVEL THAT CONTAIN BEDS OF CLAY AND SILT. MOST OF THE CEMENTING MATERIAL IS CALCIUM CARBONATE, AND CALICHE COMMONLY FORMS ON OUTCROPS. THE LOWER ALLUVIUM HAS BEEN TILTED IN OUTCROPS AND HAS DIPS OF ONLY A FEW DEGREES. IT IS CORRELATED WITH THE DEPOSITS REFERRED TO AS THE DEFORMED GRAVEL BY DAVIDSON (1961) AND COOLEY AND DAVIDSON (1963). WHERE PRESENT, THE DEPOSITS GENERALLY ARE 200 TO 400 FEET THICK IN THE AREA NEAR SCOTTSDALE. IN OTHER PARTS OF PARADISE VALLEY THE LOWER ALLUVIUM MAY BE CONSIDERABLY THICKER. THE LOWER ALLUVIUM YIELDS MUCH WATER TO WELLS IN MOST OF PARADISE VALLEY

UNCONFORMITY

Tr

RED UNIT

REFERRED TO INFORMALLY BY SOME INVESTIGATORS AS THE BEDS OF PAPAGO BUTTES. CHIEFLY SANDSTONE TO COARSE CONGLOMERATE THAT CONTAINS GRANITE PEBBLES TO BOULDERS IN OUTCROPS AT CAMELBACK MOUNTAIN, PAPAGO BUTTES, AND NEAR SAWIK MOUNTAIN. IN PAPAGO BUTTES THE RED UNIT INCLUDES SOME OLDER ROCKS. IT IS A THIN-BEDDED SILTSTONE AND SANDSTONE IN THE EXPOSURE ON TEMPE BUTTE. IN THE PAPAGO BUTTES-TEMPE BUTTE AREA THE WHOLE SEQUENCE IS MORE THAN 2, 000 FEET THICK; THE BASAL PART CONSISTS MAINLY OF CONGLOMERATE AND SANDSTONE, AND THE UPPER PART IS SILTSTONE AND SANDSTONE. NEAR SCOTTSDALE, THE BASAL CONGLOMERATE AND SANDSTONE BEDS ARE MORE THAN 500 FEET THICK. THE RED UNIT MAY UNDERLIE MUCH OF PARADISE VALLEY. THE CONGLOMERATE ENCOUNTERED IN WELL (A-3-4)2baa2 AND THE PINK SILTSTONE ENCOUNTERED BELOW ABOUT 2, 650± FEET IN WELL (A-4-4)8d PROBABLY ARE THE LATERAL EQUIVALENTS OF THESE DEPOSITS. IN THE EXPOSURE NEAR SCOTTSDALE, THE RED UNIT HAS BEEN DEFORMED AND IS TILTED BETWEEN 20° AND 50°. THE RED UNIT IS KNOWN TO YIELD WATER TO WELLS NEAR SCOTTSDALE

Tb

BASALT

INCLUDES SOME BASALTIC ANDESITE AND ANDESITE. THE BASALT PROBABLY IS INTERBEDDED WITH THE OLDER ALLUVIUM (Tao) AND UNDERLIES THE YOUNGER ALLUVIUM (Tay). NEAR CAVE CREEK, CINDERY MATERIAL IS INCLUDED WITH THE FLOWS. THE BASALT YIELDS WATER TO WELLS WHERE IT IS FRACTURED, INCLUDES CINDERY MATERIAL, OR CONTAINS INTERBEDS OF SEDIMENTS

Tv

RHYOLITE TO ANDESITE FLOWS AND TUFFS

THESE VOLCANIC ROCKS PROBABLY OVERLIE AND ARE INTERBEDDED WITH THE RED UNIT (Tr). THEY ARE NOT KNOWN TO BE WATER BEARING

QUATERNARY

TERTIARY

p€r

BASEMENT ROCKS

CONSIST MAINLY OF GRANITE AND SCHIST OF PRECAMBRIAN AGE. QUARTZITE IS PRESENT IN THE MCDOWELL MOUNTAINS. IN PLACES WHERE THE BASEMENT ROCKS ARE HIGHLY FRACTURED OR DEEPLY WEATHERED, PARTICULARLY UNDERLYING PEDIMENTS, THEY YIELD A SMALL AMOUNT OF WATER TO WELLS

PRECAMBRIAN

CONTACT

545
p€r

COMPLETE THICKNESS, IN FEET, OF ALLUVIUM PENETRATED BY A WELL; PRECAMBRIAN ROCKS (p€r) OR RED UNIT (Tr) WERE PENETRATED BENEATH THE ALLUVIUM

400+

PARTIAL THICKNESS, IN FEET, OF ALLUVIUM PENETRATED BY A WELL

APPROXIMATE NORTHERN LIMIT OF RECOGNITION OF SAND AND GRAVEL IN UPPER ALLUVIUM DEPOSITED BY THE SALT RIVER

APPROXIMATE SOUTHWESTERN LIMIT OF RECOGNITION OF LOWER ALLUVIUM ALONG THE FLANKS OF PAPAGO BUTTES AND PHOENIX MOUNTAINS

APPROXIMATE NORTHERN LIMIT OF RECOGNITION OF RED UNIT NEAR SCOTTSDALE

400

LINES OF EQUAL DEPTH TO TOP OF GRAVEL, PROBABLY OF THE LOWER ALLUVIUM. INTERVAL 200 FEET. DATUM IS LAND SURFACE

750

LINES OF EQUAL DEPTH TO TOP OF GRANITE, SCHIST, RED UNIT, AND VOLCANIC ROCKS. INTERVAL 250 FEET. DATUM IS LAND SURFACE

FIGURE 4.--RECONNAISSANCE GEOLOGY OF PARADISE VALLEY.

and the alluvial deposits combine hydrologically to form a single aquifer system.

The upper alluvium is composed of unconsolidated sand and coarse gravel and is recognized mainly in the southern part of the valley. In the past the unit yielded large amounts of ground water; however, at the present time, the unit is dry in most of this area because of the decline of the water level in the last two decades. The middle alluvium is weakly cemented and contains considerable amounts of clay and silt; it yields only small amounts of water. The lower alluvium consists principally of weakly to moderately cemented sand and gravel and is widely distributed in the valley; it yields large amounts of water to most wells. The conglomeratic rock of the red unit, which underlies the lower alluvium in much of the valley, has been developed only near Scottsdale, where it yields some water to wells. In places, however, the unit is mainly siltstone or silty sandstone and would yield little water to wells.

In general, the water that is stored in the sediments is the result of an accumulation over a long period of time, although some new water is being continually added. Water enters the subsurface materials from floodflow in Cave Creek at the northwest edge of the valley, from runoff from the mountain areas tributary to the valley, and from seepage from canals and irrigated fields in the southern part of the valley. During times of flow, the normally dry Salt River may contribute some recharge to the ground-water reservoir in the southern part of the valley. It is probable that some water was added to the upper part of the aquifer system in the southern part of the valley as a result of the two unusual flow events in 1965-66, when the Salt River flooded a large area along the stream channel. Briggs and Werho (1966, p. 9) stated that water levels in wells in this part of the valley rose considerably during the April 1965 flow event.

When stored water from the Salt and Verde Rivers system of reservoirs was first transported through canals and applied to cultivated fields in Paradise Valley, some water seeped downward to recharge the ground-water reservoir, as shown by ground-water mounds that formed under the canals and irrigated fields (figs. 5, 7). Recently, most of the canals have been lined with impervious materials so that this source of recharge has been reduced, although some water still moves into the ground-water reservoir beneath the irrigated fields.

The earliest depth-to-water data available for Paradise Valley are for 1914 (Meinzer and Ellis, 1915). The contours of the altitude of the water table (fig. 5) have been constructed using these depth-to-water measurements; current topographic maps were used to determine the land-surface altitude at the wells. In 1914 the ground-water reservoir had been

affected only slightly by a small amount of pumping from wells and by the seepage of water from the Arizona Canal and the irrigated lands. Prior to any ground-water development, the water table probably sloped uniformly from the north end of the valley toward the Salt River. The apparent ground-water mound indicated by the 1, 220-foot contour for 1914 (fig. 5), which extends nearly 2 miles north of the canal, is the result of seepage and shows the movement of ground water northward from the canal (McDonald and others, 1947). The contours of the water level for 1946 (fig. 6) show that the mound was no longer present because of withdrawal of ground water along and south of the canal. The contours of the water level for 1966 (fig. 7) show a different flow pattern that has resulted from increased withdrawal of ground water. In a few places pumping of ground water has created cones of depression. One cone is near Scottsdale, and part of the ground water that formerly moved southward into the Salt River Valley is intercepted by this cone. The profiles of the water level shown in figure 8 indicate the gradient of the water surface along a longitudinal section extending from the north edge of T. 3 N. southward to the Salt River for 1914, 1946, and 1966. The mound north of the Arizona Canal is apparent in the profile for 1914; the profile shows that in 1946 the slope of the water table was fairly uniform; and the 1966 profile shows the depression in the water surface near Scottsdale caused by continual pumping of ground water.

Hydrologic Characteristics of the Aquifer System

In any area where ground water is withdrawn from storage, and particularly in areas where increased withdrawal is anticipated, it is important to ascertain the hydrologic characteristics of the aquifer. These characteristics control the amount of stored water that can be extracted and the transmission of water through the aquifer. A determination of the characteristics makes it possible to understand the physics of the ground-water system and helps to evaluate the ground-water resources of an area in relation to development of these resources.

The rate at which an aquifer will yield water to wells is a function of the transmissibility of the aquifer. The coefficient of transmissibility is defined as the rate of flow of water, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated height of the aquifer under a hydraulic gradient of 100 percent (Ferris and others, 1962). The quantity of water that the aquifer releases from or takes into storage per unit surface area per unit change in head normal to that surface is called the coefficient of storage; for water-table conditions the storage coefficient is essentially equivalent to the specific yield (Ferris and others, 1962).

FIGURE 5.--WATER-LEVEL CONTOURS AND GENERALIZED FLOW PATTERN IN PARADISE VALLEY, 1914.

FIGURE 6.--WATER-LEVEL CONTOURS AND GENERALIZED FLOW PATTERN IN PARADISE VALLEY, 1946.

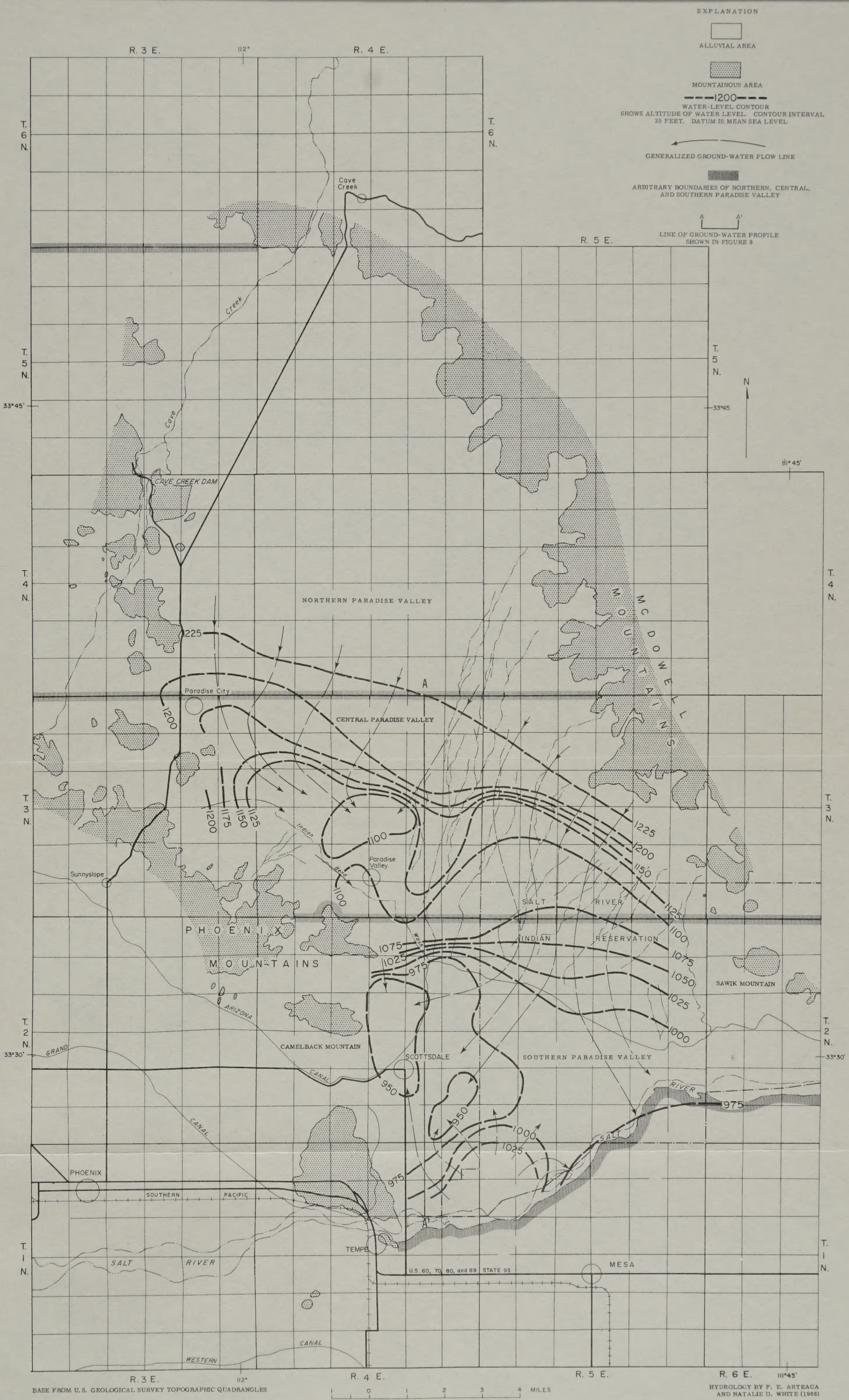
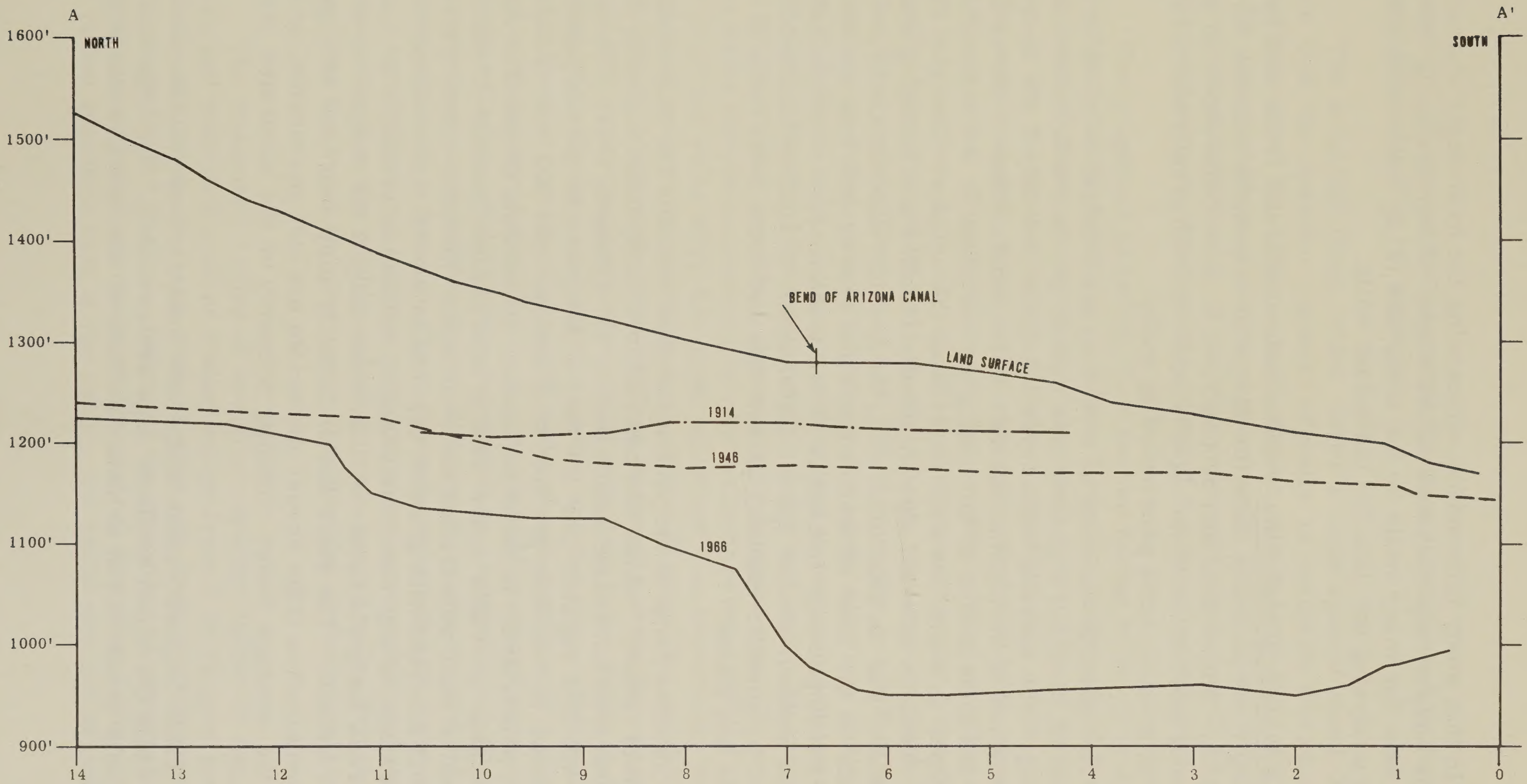


FIGURE 7.--WATER-LEVEL CONTOURS AND GENERALIZED FLOW PATTERN IN PARADISE VALLEY, 1966.



DATUM IS MEAN SEA LEVEL

MILES NORTH FROM SALT RIVER (SEE FIG. 2)

VERTICAL SCALE GREATLY EXAGGERATED

FIGURE 8.--GROUND-WATER PROFILES, PARADISE VALLEY.

In this study information concerning the hydrologic characteristics of the aquifer was obtained in two ways: (1) by analyzing specific-capacity data for many wells in the area; and (2) by conducting pumping tests and analyzing the data for individual wells.

Analysis of well data.--Information obtained from well records or pumping tests provides data for the yield-drawdown relation for individual wells. These data can be analyzed to show differences in water-bearing characteristics of the aquifer system, both areally and in relation to the stratigraphic units penetrated by wells.

The specific capacity of a well is the relation of yield to drawdown—that is, its yield in gallons per minute per foot of drawdown caused by pumping. The specific capacity is a function not only of the hydrologic characteristics of the aquifer but also of the construction of the well, particularly the distribution of the casing perforations in the saturated zone and the depth to which the well penetrates the aquifer. The specific capacity of a well is affected also by the distribution and pumping status of nearby wells. For an individual well, the specific capacity computed from tests made at the time of well completion—provided that the well was properly developed—is indicative of the transmission characteristics of the aquifer system at that time. Differences in aquifer characteristics are shown by specific-capacity values obtained from tests made at different places and times.

Another form of the yield-drawdown relation for individual wells is the "yield factor," which has been defined as specific capacity divided by the saturated thickness, multiplied by 100 (Poland, 1959). Thus, it is literally specific capacity per 100 feet of saturated thickness penetrated, i.e., gallons per minute per foot of drawdown per 100 feet of saturated thickness penetrated. In some instances, conversion of specific capacity to yield factor provides more usable information because it eliminates total depth of well penetration as a variable. Specific capacity of a well usually will increase with greater depth of saturated materials penetrated simply because of a greater thickness of sediments available to yield water, whereas the yield factor will increase only if the deeper material is more permeable. The yield factor actually may decrease with greater depth of penetration if the deeper materials are less permeable, as it represents the average water-yielding property of the saturated material penetrated.

Table 5 shows values of specific capacity and yield factor for individual wells for which drillers' logs are available. The logs and static water levels measured at or near the time of the specific-capacity test

were used to determine the saturated thickness penetrated in the different stratigraphic units (fig. 4; table 2).

The available data, which cover a time span of about 20 years, indicate that the specific capacity of wells in southern Paradise Valley ranges from about 5 to 103 gpm (gallons per minute) per foot of drawdown (table 5); the specific capacities of most wells range from about 25 to 60 gpm per foot of drawdown. Yield factors range from 1.3 to 44 gpm per foot of drawdown per 100 feet of saturated thickness penetrated.

The graphical plots (fig. 9) of the two forms of the yield-drawdown relation for individual wells in southern Paradise Valley show large variance in each of these parameters; however, inspection of the graphs in relation to the thickness of the different stratigraphic units penetrated provides some valuable information regarding the hydrologic characteristics of these units. For example, on the graph showing specific capacity, the five points (Nos. 1, 9, 12, 15, 25) that represent wells obtaining water principally from the middle alluvium indicate an average yield factor of about 2. Five points (Nos. 2, 4, 16, 17, 26) on the graph that represent wells obtaining water principally from the upper alluvium indicate yield factors of from 35 to 40. Data are insufficient to assign quantitative values of yield factor for the lower alluvium and the red unit. An inspection of figure 9B, however, provides a qualitative comparison. In several instances wells have been deepened or new wells have been drilled to greater depths near old wells after the upper alluvium was essentially dewatered (see pairs of reference numbers, i. e., 2 and 2a, figs. 9A and 9B). Comparison of data from early tests [before deepening when the upper alluvium was still contributing to the yield] with data from later tests [after deepening when the upper alluvium was dry but the lower alluvium and (or) the red unit were contributing to the yield] shows that specific capacity increased with the deepening [due to the greater thickness of permeable sediments] but that the yield factor decreased or changed very little. Only when large thicknesses of the lower alluvium were penetrated did the yield factor significantly increase. Thus, it can be concluded that the upper alluvium, lower alluvium, and red unit are more permeable and yield more water to wells than the middle alluvium and, specifically, that the middle alluvium has the least and the upper alluvium the greatest water-yielding ability.

The computed values of specific capacity (table 5) for wells in northern and central Paradise Valley range from 2 to 31 gpm per foot of drawdown, but most are less than 15 gpm per foot of drawdown. Yield factors range from 0.3 to 8.7. Although the thickness of permeable material penetrated by wells in northern and central Paradise Valley is similar to that in the southern part of the valley, the wells are not as productive.

The wells were drilled through large thicknesses of the upper and middle alluvium but do not penetrate as great a thickness of the lower alluvium as do many wells in the southern part of the valley; the upper alluvium probably is dry in most of this area.

Analysis of pumping-test data. --The hydrologic characteristics of aquifers can be determined by pumping tests in which the effect of pumping a well at a known rate is measured in the pumped well and in nearby observation wells. The data obtained during the tests are analyzed using mathematical formulas that relate the hydrologic properties of the aquifer to the change in water levels in and near the pumped well. The different formulas that have been derived are described in several publications (Brown, 1953; Ferris and others, 1962).

To some extent, values of the hydrologic characteristics determined from pumping tests must be considered as point data and not as regional characteristics for a widespread nonhomogeneous aquifer system. Similarly, data obtained from pumping tests apply only to the water-bearing zones penetrated by the wells used in the tests.

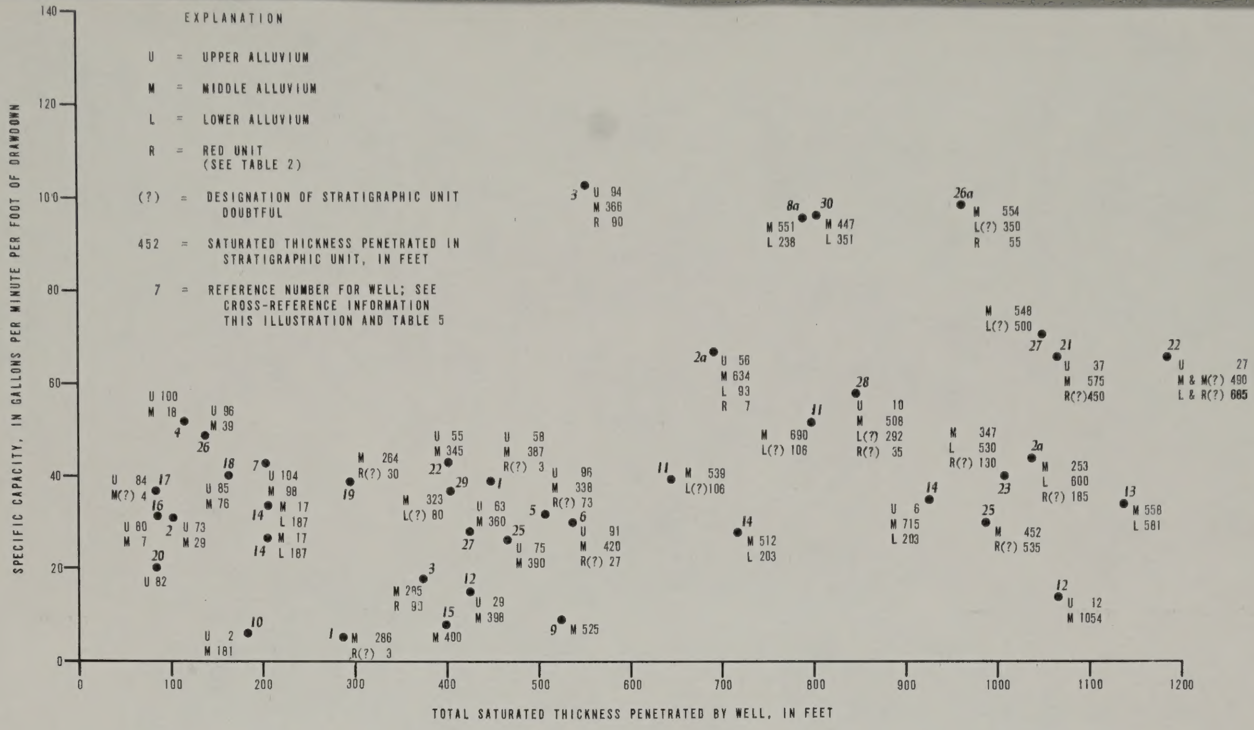
Data from several short-term pumping tests conducted on wells in southern Paradise Valley were available for computing values of transmissibility; none of the tests produced data for computing the storage coefficient of the aquifer. The data obtained from the tests were analyzed, and values of transmissibility were computed using Jacob's modification of the Theis nonequilibrium formula or the Theis recovery formula (Ferris and others, 1962, p. 98-102), depending on the data obtained. The methods involve plotting of the data on semilogarithmic coordinate paper using the logarithmic scale for values of t (time since pumping started or stopped) and the arithmetic scale for values of s (drawdown or recovery of the water level, in feet). Subsequently, the transmissibility of the aquifer at and near the location of the well is determined from the formula:

$$T = \frac{264\,Q}{\Delta s}$$

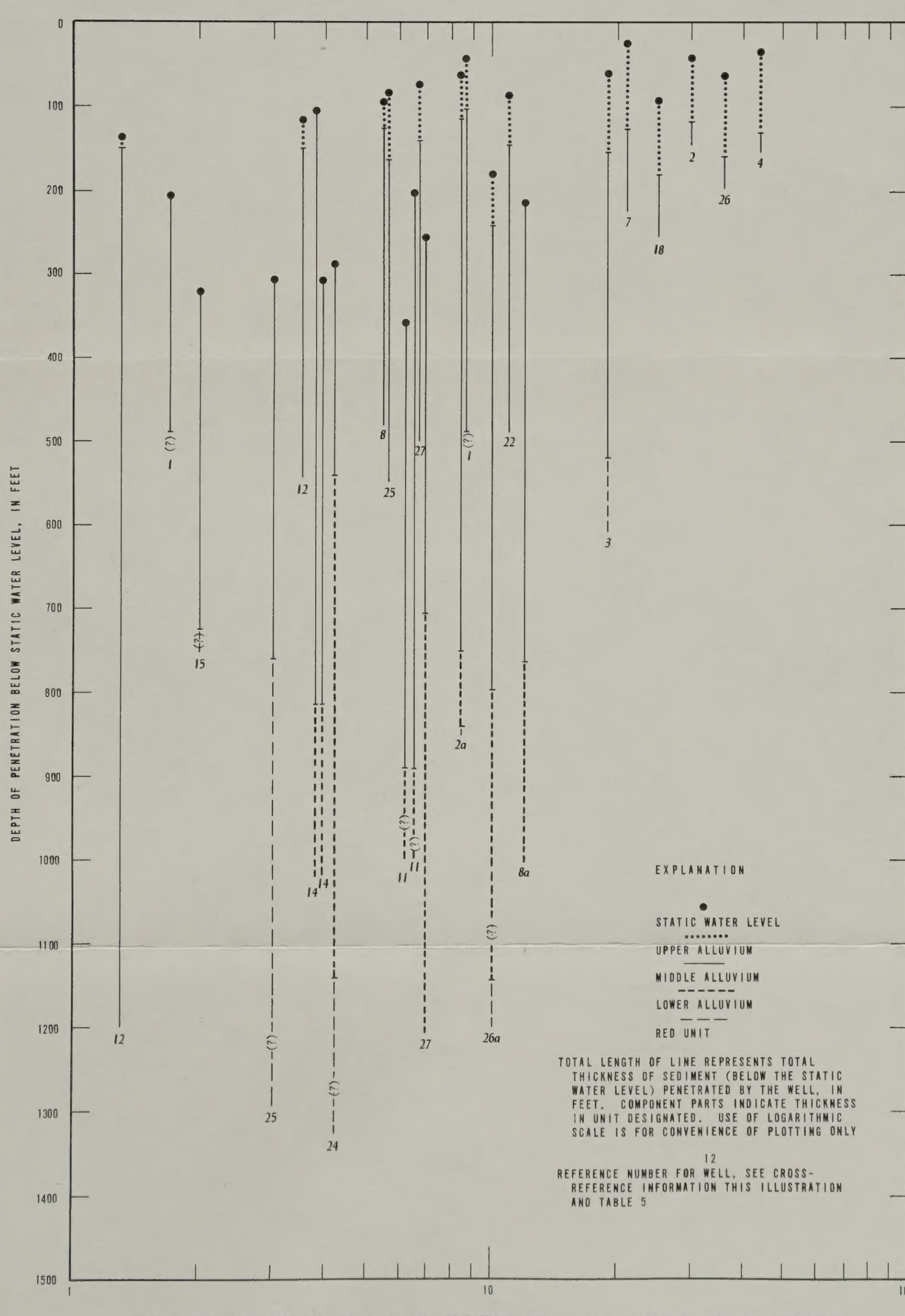
where

- T = transmissibility, in gallons per day per foot;
- Q = discharge of the well, in gallons per minute; and
- Δs = change in drawdown or recovery, in feet, per log cycle of time.

Values of transmissibility obtained from the tests are shown in table 1; graphs and values of transmissibility for three of the tests are shown in figure 10.



A. SPECIFIC CAPACITY VERSUS SATURATED THICKNESS OF PERMEABLE MATERIAL.



CROSS-REFERENCE INFORMATION
(SEE TABLE 5)

WELL LOCATION	REFERENCE NUMBER
(A-1-4)1aba	1
1cd	2
1cda	2a
2dbb	3
2dcc	4
11acd	5
11cda	6
11dcb	7
(A-2-4)11dc	8
11dcc1	8a
12aad	9
12bb	10
12bdd	11
12daa	12
12ddd	13
13caa	14
14acb	15
14cbb	16
22aab	17
22da	18
22dcc	19
23bbb	20
23ddd	21
24bad	22
25aaa	23
25aab	24
25bcd	25
25cd	26
25cdd	26a
25dca	27
35aab	28
35dcc	29
(A-2-5)16aaa	30

NOTE: A FEW WELLS SHOWN IN TABLE 5 ARE NOT PLOTTED DUE TO SPACING LIMITATIONS ON THE GRAPHS

HYDROLOGY BY NATALIE D. WHITE (1967)

B. YIELD FACTOR VERSUS DEPTH OF PENETRATION IN SATURATED PERMEABLE MATERIAL.

FIGURE 9.--YIELD-DRAWDOWN RELATION FOR WELLS IN SOUTHERN PARADISE VALLEY.

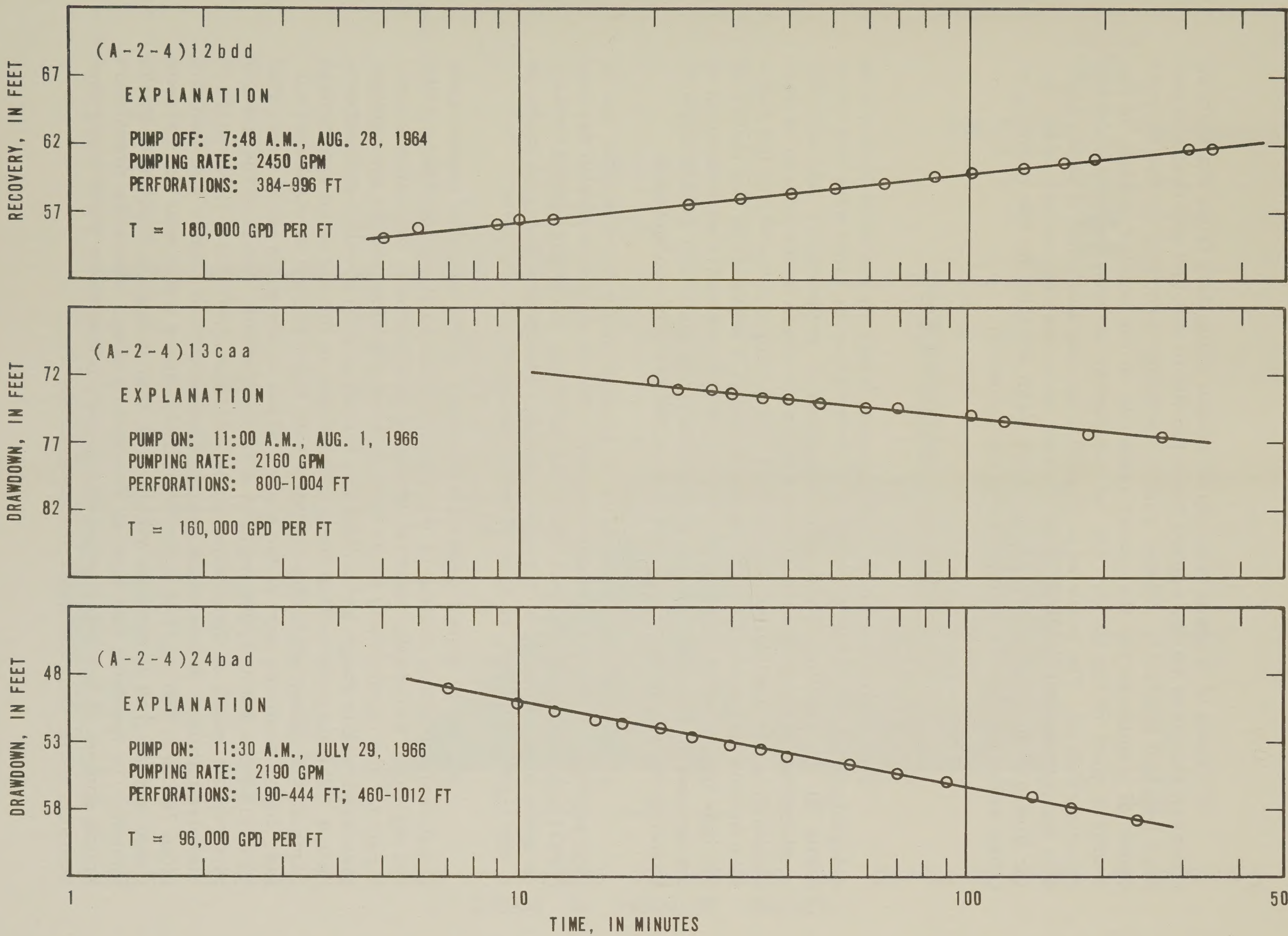


FIGURE 10.--PUMPING-TEST DATA, PARADISE VALLEY.

Values of transmissibility computed using data from six tests in southern Paradise Valley ranged from 62, 000 to 180, 000 gpd (gallons per day) per foot (table 1). These values, although probably in the correct order of magnitude for the transmissibility of the aquifer system in the southern part of the valley, can be considered as only approximate for several reasons. The tests were of such short duration that it is possible that the full effects of withdrawal of water were not determined; also, water levels in the wells tested may have been affected by the pumping of other wells in the area before or during the tests.

Chemical Quality of the Ground Water

The chemical quality of the ground water in Paradise Valley was determined from chemical analysis of water samples from selected wells (table 3). In addition, field determinations of temperature and specific conductance of water from selected wells were made by the Bureau of Reclamation in the summer of 1965 and by the Geological Survey in the summer of 1966 (table 4). Specific conductance is a measure of the ability of the ions in solution to conduct an electrical current and is an indication of the amount of dissolved solids in the water; the dissolved-solids content, in milligrams per liter, is about 0. 6 of the specific conductance.

In general, the suitability of ground water for domestic use is indicated by the dissolved-solids content. The U. S. Public Health Service (1962) has recommended that water for drinking purposes should contain no more than 500 mg/l of dissolved solids. Water containing as much as 1, 000 mg/l, however, is used if better water is not available.

Figure 11 shows generalized zones of the specific conductance and dissolved-solids content of the ground water in Paradise Valley without regard to well depth, interval of casing perforations, or material penetrated. The conductivity range of each zone was assigned an appropriate dissolved-solids range by multiplying the measured specific conductance by 0. 6. The map shows that the ground water in the northern and central parts of the valley generally contains less than 500 mg/l of dissolved solids. In the southern part of the valley, most of the wells yield water that contains from 500 to 1, 000 mg/l of dissolved solids. South of the area of this report, much of the ground water contains more than 1, 000 mg/l of dissolved solids. A few wells near Scottsdale produce water that contains from 700 to 1, 500 mg/l of dissolved solids; some wells near the Arizona Canal and the Salt River also yield water that is high in dissolved-solids content. In northern and central Paradise Valley, where the dissolved-solids content of the water generally is low, a few wells yield water that contains more than 600 mg/l of dissolved solids.

FIGURE 11.--GENERALIZED ZONES OF SPECIFIC CONDUCTANCE AND DISSOLVED SOLIDS IN GROUND WATER IN PARADISE VALLEY.

Most of the wells in the valley penetrate several water-bearing units. The water from these wells represents a composite sample and does not indicate the quality of the water from the individual stratigraphic units. Chemical analysis of the water may indicate the quality of water from a particular water-bearing unit if that unit is open to the well through selective perforations in the casing. Therefore, the chemical quality of water from a well can be controlled to some extent by perforating the well casing at selected depths.

Many of the deep wells in the southern part of the valley obtain water from only the lower alluvium and the red unit, partly because of the manner in which the well casing is perforated. Most wells that penetrate the lower alluvium yield water that contains less than 500 mg/l of dissolved solids. [See wells (A-2-4)11dcb and (A-2-4)13caa in table 3.]

An important constituent in water for domestic and municipal use is fluoride. The recommended limits for fluoride concentration differ, according to the annual average of the maximum daily air temperatures. The upper limit of fluoride in drinking water in Paradise Valley is about 0.8 mg/l, and the optimum concentration is about 0.7 mg/l (U.S. Public Health Service, 1962). Excessive amounts of fluoride in drinking water cause mottling of the enamel in children's teeth, but amounts in the optimum range may prevent tooth decay.

Concentrations of fluoride in ground water sampled during this study ranged from 0.3 to 1.2 mg/l; however, nearly all the water contained less than 0.8 mg/l. Concentrations of fluoride greater than those allowed were not restricted to water from wells in any particular part of the valley or from any particular stratigraphic unit. McDonald and others (1947), however, reported fluoride concentrations of as much as 3.2 mg/l in water from a few shallow wells. These wells were in or near bedrock outcrops.

Hardness of water is the property attributable to the presence of the alkaline earths, principally calcium and magnesium, and sometimes is referred to as the soap-consuming property of water. Hard water causes incrustation in pipes, cooking utensils, and other household fixtures and is generally objectionable when present in excess of about 100 mg/l. In many reports of the Geological Survey, hardness of water has been classified as follows:

0-60 mg/l	=	soft water
61-120 mg/l	=	moderately hard water
121-180 mg/l	=	hard water
$>$180 mg/l	=	very hard water

Most of the wells sampled yielded water having objectionable hardness.

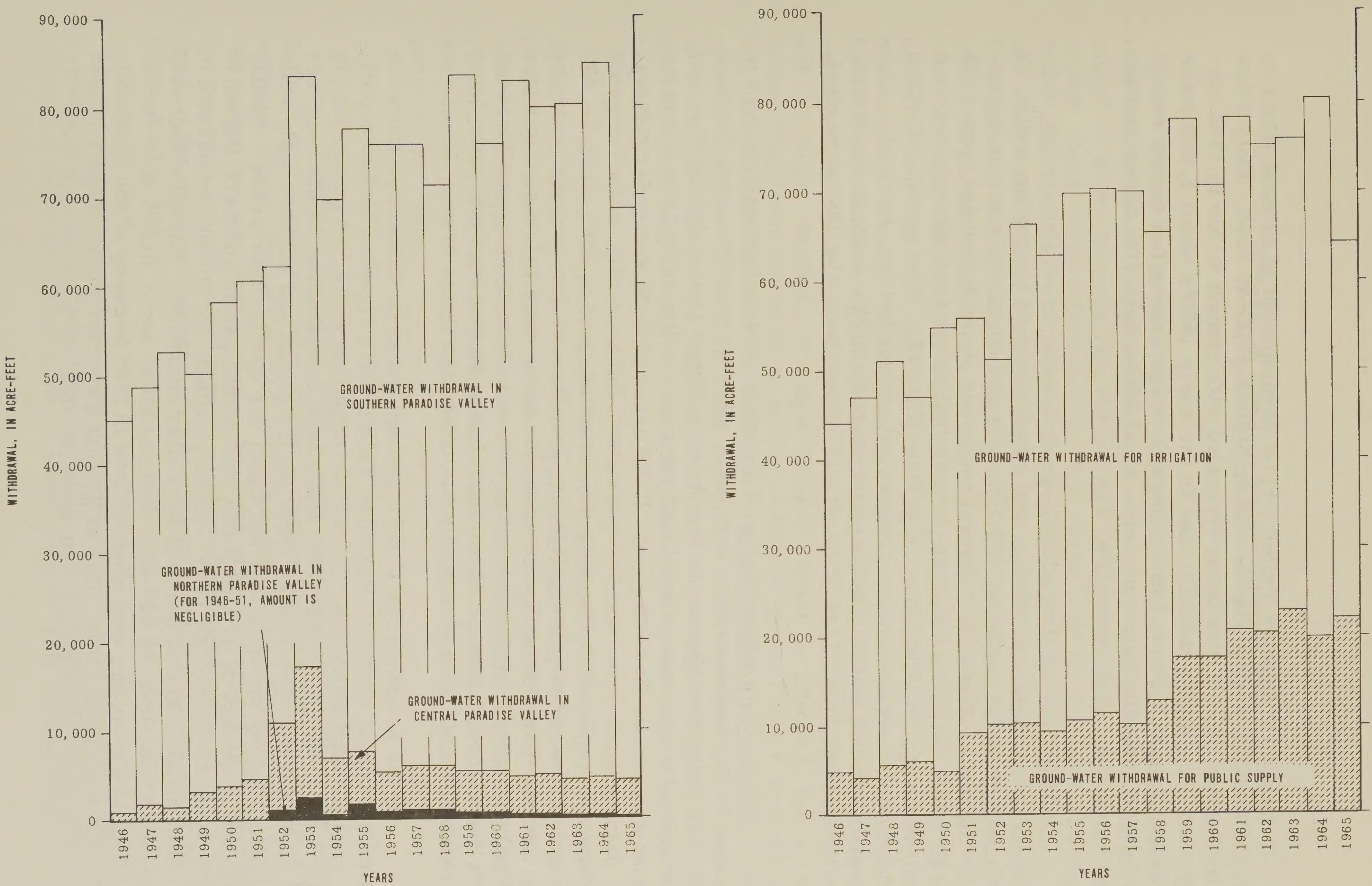
DEVELOPMENT OF GROUND WATER

History

The history and economic growth of Paradise Valley parallel those of the rest of southern and central Arizona in their relation to the availability and development of the water resources. Land north of the Arizona Canal (fig. 2) was opened to homesteading prior to 1914 (Meinzer and Ellis, 1915). The small amount of development that took place prior to 1946, however, was limited mostly to stock raising; in 1946 about 2,200 acres of land was being irrigated using ground water north of the Arizona Canal (Barr, 1948). A small amount of ground water was used for irrigation and domestic purposes as early as 1900 (Lee, 1905) between the Arizona Canal and the Salt River, including the Salt River Indian Reservation. In this part of the valley slightly more than 10,000 acres (Barr, 1948) was irrigated in 1947, using surface water and ground water. Subsequent to this time, there was an increase in cultivated acreage on the Salt River Indian Reservation but a corresponding decrease in other parts of the valley because of the replacement of farmland by urban development. From 1946 through 1965, about 1.4 million acre-feet of ground water was withdrawn from the aquifer system in Paradise Valley. The pattern of ground-water development in relation to time and amount differs in northern, central, and southern Paradise Valley (fig. 2).

Northern Paradise Valley.--Northern Paradise Valley (fig. 2) is essentially undeveloped. About 600 acres of land was irrigated in 1953, but by 1966 most of the land had been taken out of cultivation.

At the present time (1966), ground water is withdrawn mainly for domestic use. Wells being used in the area include 2 public supply, 1 irrigation, and about 30 domestic wells; in addition, there are about 19 wells that are not in use. In a few places, water is transported to homes in tank trucks or by other means for domestic use. Only a minor amount of ground water has been withdrawn from the alluvium in the northern part of the valley, although it is the main source of water in the area. From 1946 through 1951, the amount of ground water pumped each year was negligible; the largest amount withdrawn in a single year was less than 3,000 acre-feet in 1953 (fig. 12). Slightly more than 10,000 acre-feet of ground water was withdrawn from the ground-water reservoir in northern Paradise Valley from 1946 through 1965. Most of the withdrawal has taken place in the southwest end of the area.



A. GROUND-WATER WITHDRAWAL, NORTHERN, CENTRAL, AND SOUTHERN PARADISE VALLEY.

B. GROUND-WATER WITHDRAWAL FOR IRRIGATION AND PUBLIC SUPPLY, SOUTHERN PARADISE VALLEY.

FIGURE 12.--GROUND-WATER WITHDRAWAL IN PARADISE VALLEY.

Central Paradise Valley.--The development of ground water in central Paradise Valley (fig. 2) was negligible prior to 1946. Only a few hundred acres of land was being irrigated with ground water in 1946; development increased gradually, and in the early 1950's about 3,000 acres was being irrigated (Barr, 1954). Since that time, there has been a steady decrease in irrigated acreage, and, as of 1966, only 700 acres remain under cultivation in the area (fig. 2).

At the present time (1966), ground water is withdrawn for irrigation, public supply, domestic, and stock use—14 irrigation wells, 22 public-supply wells, and about 50 domestic and stock wells are in operation in the area. Annual withdrawal of ground water increased from 1946 through 1953; in 1954, however, withdrawal decreased sharply and has remained nearly constant since that time (fig. 12). The amount of water used for public supplies has increased but, nevertheless, is small. The amount of ground water withdrawn from the aquifer system in central Paradise Valley from 1946 through 1965 was about 100,000 acre-feet.

Southern Paradise Valley.--Agricultural development in southern Paradise Valley began earlier than in the other parts of the area. Surface water was being transported in the Arizona Canal in the late 1800's, and some ground water was pumped into the canal in the early 1900's, but the amount was small. In 1946 about 12,000 acres of land was under cultivation, using ground water and surface water. Subsequently, some irrigated acreage was replaced by housing subdivisions, and in 1966 about 10,000 acres of land was being irrigated (fig. 2). Most of the irrigated acreage is on the Salt River Indian Reservation; the water used to irrigate this land is supplied partly from surface water diverted from the Arizona Canal and partly from ground water. About 30,000 acre-feet of surface water from the Arizona Canal is used annually for irrigation in the area.

At the present time (1966), ground water is withdrawn from the aquifer system in southern Paradise Valley for irrigation, public supply, and domestic and stock use. About 45 irrigation wells, 20 public-supply wells, and 9 domestic and stock wells are in operation in the southern part of the valley. Some water from the irrigation and public-supply wells is transported by conduits and the canal for use in other areas. Nearly 1,280,000 acre-feet of ground water was withdrawn in southern Paradise Valley from 1946 through 1965—about 12 times the amount withdrawn in the northern and central parts of the valley combined. Annual withdrawal increased from about 44,000 acre-feet in 1946 to about 80,000 acre-feet in 1964 (fig. 12); pumpage was slightly less in 1965 because of the availability of more surface water. Use of ground water for public supply in 1965 was about four times the amount used for this purpose in 1946 (fig. 12).

Effects of Ground-Water Withdrawal

Prior to the development of ground water in an area, the aquifer is in approximate hydrologic balance—i. e., on a long-term basis the amount of water moving into the aquifer is equal to that moving out, although short-term inflow and outflow rates may be far out of balance. When man imposes stresses on the ground-water system in the form of new discharge points, such as wells, the system responds by a change in flow pattern. When a well is first pumped, the water level in and near the well is lowered, creating a cone of depression and allowing water to move into the well. When many wells are pumped in an area, the cones of depression overlap, and regional lowering of the water level results. This process will continue unless natural or artificial recharge is sufficient to balance the amount of ground water being withdrawn; if such recharge is sufficient, a new state of equilibrium will be attained, and water levels will no longer decline. If a new balance cannot be attained, the ground water withdrawn comes from storage—that is, ground water that has accumulated in the subsurface during a long period of time—and water levels will continue to decline. The amount of water available from storage in Paradise Valley was not computed for this study; however, based on the thickness and areal extent of the permeable materials, it is known to be several millions of acre-feet.

At the present time (1966), the amount of ground water being withdrawn from the aquifer system greatly exceeds the amount being recharged; therefore, most of the water is being withdrawn from storage, and water levels will continue to decline in the valley. Conditions, in relation to the effects of withdrawal, the state of development, and the current depths to water, are different in the northern, central, and southern parts of the valley.

Northern Paradise Valley. --As indicated previously, the development of ground water in northern Paradise Valley has been minor to the present time. Therefore, the decline of the water levels in this part of the valley has been small. Local declines of 1 to 2 feet per year have been measured in individual wells in the center of the area (table 1). In a small area in the southwest corner, however, water levels declined about 25 feet (figs. 13 and 14).

In general, data are insufficient to construct contours of the depth to water in northern Paradise Valley (fig. 15); however, measurements in individual wells show that depth to water ranges from about 250 feet below

the land surface in the southwest part of the area to as much as 740 feet near the north end (table 1).

Central Paradise Valley.--Most of the ground-water withdrawal in central Paradise Valley has been concentrated in a small part of the area. From 1946 to 1966 (fig. 13), water-level declines ranged from about 25 feet along the north edge to about 125 feet in a small area near the southwest corner. From 1961 to 1966 (fig. 14), water-level declines ranged from zero along the northeast edge to about 50 feet in a 2-square-mile area near the southwest corner. Water-level declines of as much as 25 feet occurred in a large part of central Paradise Valley from spring 1961 to spring 1966. The area encompassed by the 50-foot-decline contour (fig. 14) includes 2 irrigation wells and 3 public-supply wells, which pumped about 3,700 acre-feet of ground water from 1961 through 1965. A decline of this magnitude resulting from such a minor amount of ground-water withdrawal may indicate that the specific yield of the sediments is small. The decline, however, may have resulted from the concentration of pumping in a small area.

The contours shown on figure 15 indicate that the depth to ground water in the area ranges from about 200 feet below the land surface at the south end to as much as 350 feet near the east edge of the area. In the area of greatest ground-water development, the depth to water is generally from 200 to 275 feet below the land surface.

Southern Paradise Valley.--The southern part of the valley is the area of greatest ground-water withdrawal, and water-level declines have been relatively large. From 1946 to 1966 (fig. 13), water-level declines ranged from about 75 feet in the north edge of the area to more than 225 feet near Scottsdale. From 1961 to 1966 (fig. 14), water levels declined as much as 50 feet near Scottsdale, but there was no change in the small area near the Salt River on the south end of the valley. The water levels in this area probably were affected by the unusual flow in the Salt River in 1965-66 (Aldridge, 1966; Briggs and Werho, 1966) and by a decrease in pumpage in 1965.

The contours in figure 15 show that the depth to ground water in spring 1966 ranged from about 150 feet near the Salt River to more than 325 feet below the land surface near Scottsdale and on the east edge of the area. The water levels in a few wells near the river were less than 150 feet below the land surface (table 1).

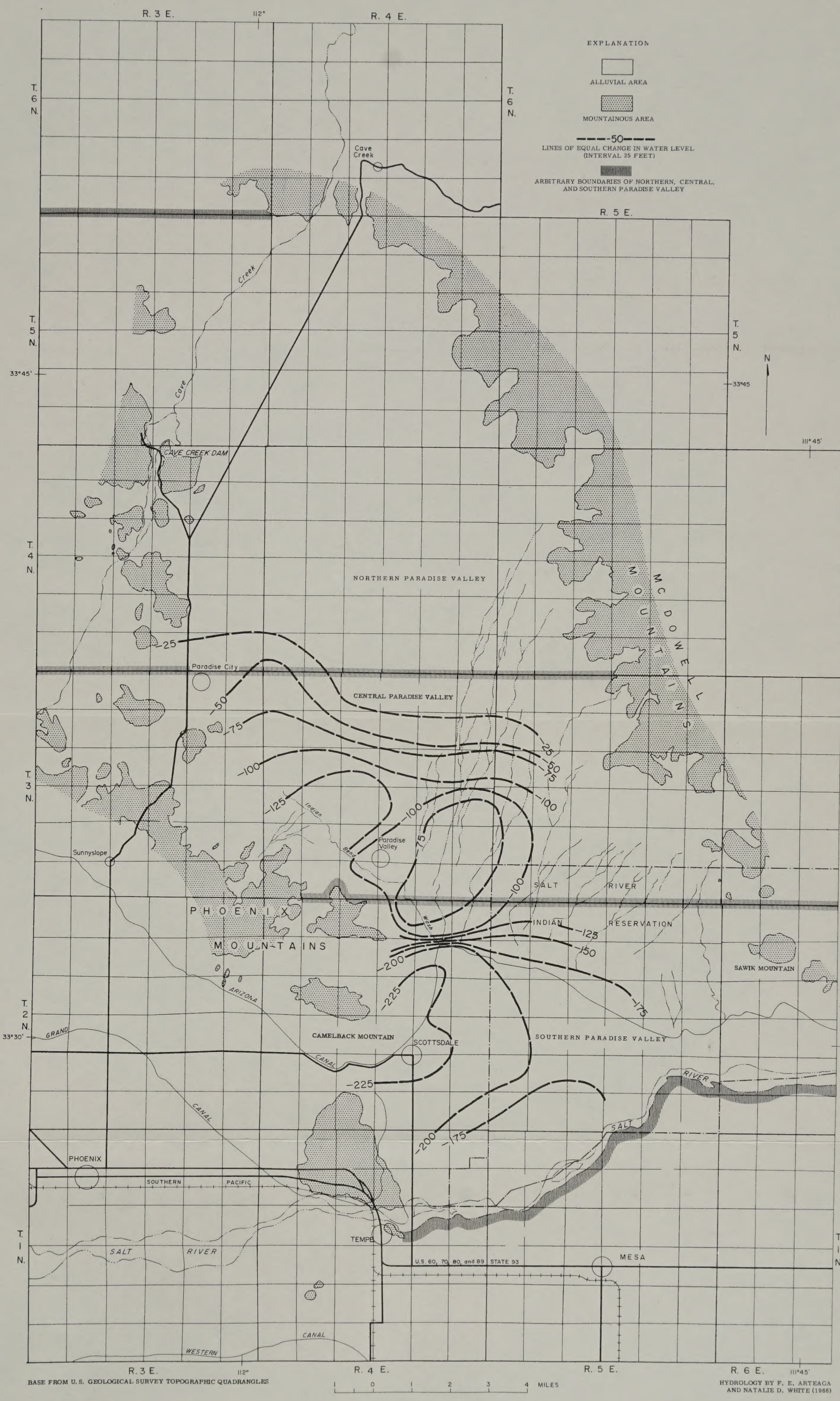


FIGURE 13.--CHANGE IN GROUND-WATER LEVELS FROM SPRING 1946 TO SPRING 1966 IN PARADISE VALLEY.

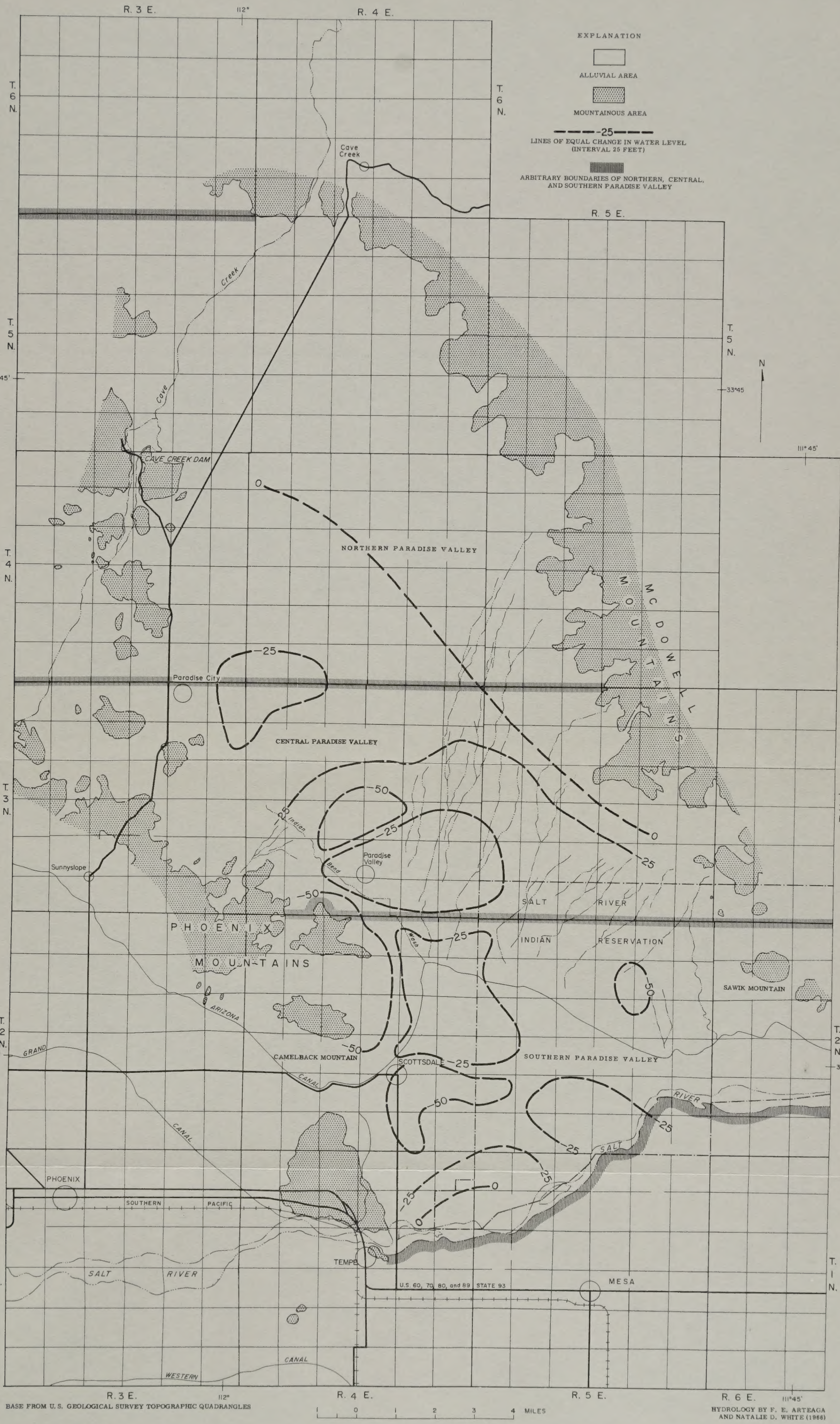


FIGURE 14.--CHANGE IN GROUND-WATER LEVELS FROM SPRING 1961 TO SPRING 1966 IN PARADISE VALLEY.

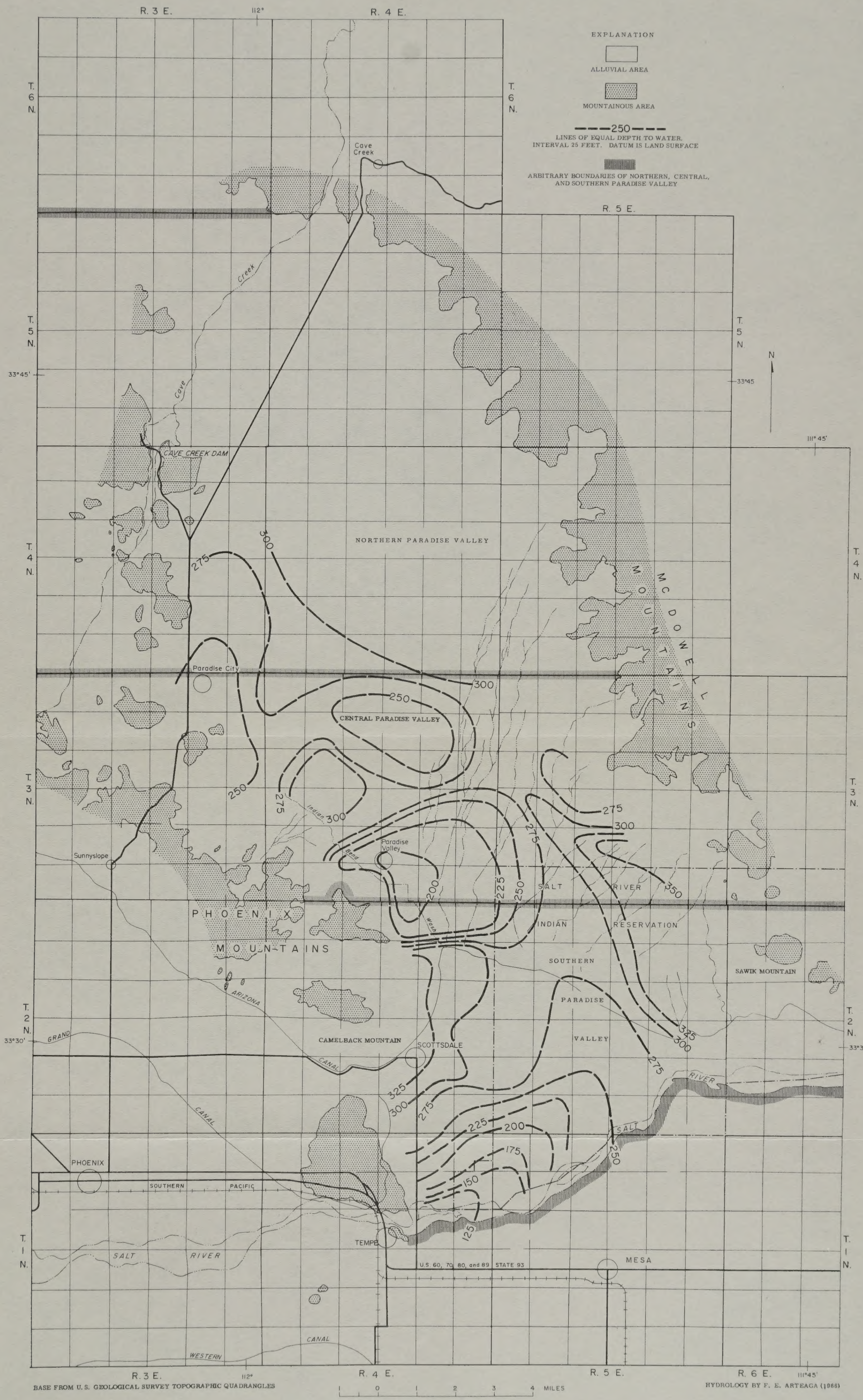


FIGURE 15.--DEPTH TO WATER FOR SPRING 1966 IN PARADISE VALLEY.

SUMMARY

The history and economic growth of Paradise Valley parallel those of the rest of southern and central Arizona in their relation to the availability and development of the water resources. Ground water is the main water supply in the valley, and its occurrence is similar to that in many alluvial-filled valleys in the Basin and Range lowlands province. A large part of the valley is underlain by more than 1,500 feet of water-yielding alluvial deposits—divided informally into the lower alluvium, the middle alluvium, and the upper alluvium. In places the alluvial deposits overlie the red unit, which is composed of conglomerate to siltstone. Although the red unit and the alluvial deposits combine hydrologically to form a single aquifer system, the units differ in permeability and, therefore, in water-yielding capacity. Analysis of yield-drawdown data for individual wells indicates differences in water-bearing characteristics of the aquifer system, both areally and in relation to the stratigraphic units penetrated. In southern Paradise Valley the upper alluvium, lower alluvium, and red unit are more permeable and yield more water to wells than the middle alluvium. Although the thickness of permeable material penetrated by wells in northern and central Paradise Valley is similar to the thickness in the southern part of the valley, the wells are not as productive. These wells were drilled through large thicknesses of the upper and middle alluvium but do not penetrate as great a thickness of the lower alluvium; the upper alluvium probably is dry in most of this part of the valley.

At the present time (1966), ground water of suitable chemical quality is withdrawn from the aquifer system in Paradise Valley for irrigation, public supply, and domestic and stock uses. The greatest withdrawal of ground water is in southern Paradise Valley. Of the 1.4 million acre-feet of ground water withdrawn from 1946 through 1965 in the entire valley, nearly 1,280,000 acre-feet was withdrawn in southern Paradise Valley—about 12 times the amount withdrawn in the northern and central parts of the valley combined. Annual withdrawal increased from about 44,000 acre-feet in 1946 to about 80,000 acre-feet in 1964; pumpage was slightly less in 1965 because of the availability of more surface water. Use of ground water for public supply in southern Paradise Valley in 1965 was about four times the amount used for this purpose in 1946, which reflects the conversion of agricultural land to an expanding metropolitan area.

APPENDIX —— BASIC DATA

Table 1.--Records of selected wells in Paradise Valley

Well number: See figure 3 for description of well-numbering system.
Perforated interval: OH, open hole.
Land-surface altitude: Land-surface altitude determined from topographic maps (scale 1:24,000).
Use of water: D, domestic; I, irrigation; Ind, industrial; N, none; PS, public supply; S, stock.
Water level: P, data furnished by city of Phoenix; R, reported by driller or owner; S, data furnished by Salt River Valley Water Users' Association.

Log: X, driller's log included in this report.
Chemical analysis: X, chemical analysis included in this report.
Pumping data: Yield given in gallons per minute. R, reported by driller from tests at time of drilling; S, data from Salt River Valley Water Users' Association. These letters are shown in the yield column but refer also to the drawdown data and, thus, indirectly to the specific capacity given.

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level: Depth below land surface (feet)	Water level: Date measured (month, year)	Log	Chemical analysis	Pumping data: Yield (gpm)	Pumping data: Drawdown (feet)	Pumping data: Date measured (month, year)	Specific capacity (gallons per minute per foot of drawdown)	Remarks
(A-1-4)1aba	....	493	24	482	90-465 OH 482-493	1,209	I	45 R 204 S 205.4	12/45 2/66 9/66	X	X	2,613 S 693 S	67 144	12/45 3/66	39 5	
1cda	1952	850	20	840	300-820 OH 840-850	1,197	I	60 R	7/52	X	X	3,580 S 1,670	54	7/52 9/66	67	
1dab	1951	370	12-8	370	190-370	1,200	N	70 R 94.4	5/51 9/66	.....	.....	....	......	....	....	Abandoned.
2dbb	1948	610	20	520	210-505 OH 520-610	1,200	I	60 R 238.6	11/48 1/66	X	X	3,700 R 1,178 S	36 67	11/48 10/65	103 18	
2dcc	1929	151	20	151	50-145	1,191	N	11 R 33 R 124.5	5/29 12/45 7/63	.....	.....	3,376 R	65	5/45	52	Capped.
11acd	1949	545	20	436	100-420 OH 436-545	1,170	I	38 R 171 S	4/49 1/66	X	X	3,076 R	94	4/49	32	
11baa	1960	1,050	20	1,050	205-1,035	1,190	PS	110 R 254 R	11/60 5/65	X	X	....	......	....	....	
11bdb	1951	....	16	....	....	1,185	I	50 R	8/51	.....	.....	....	......	....	....	
11cda	1952	581	20-16	581	....	1,170	I	43 R 97 S	9/52 1/66	.....	X	2,795 R	92	9/53	30	
(A-1-5)5aaa	1948	325	20-16	....	....	1,219	I	135.8 236.0	2/58 1/66	.....	X	....	......	....	....	
6bcc	1951	790	....	....	....	1,200	I	242.2	9/66	.....	X	1,039	......	9/66	....	
6bda	1948	300	20	300	90-300	1,201	N	42 R 164.2	3/48 9/66	.....	.....	....	......	....	....	Pump removed.
6caa	1961	596	20	590	120-180 250-580 OH 590-596	1,196	I	116 R 189 R	2/61 3/62	X	.....	....	......	....	....	
(A-2-4)1aaa	1946 1962	300 265	16 12	300 265	166-290	1,312	D	131 R 192 R	11/46 6/62	.....	.....	....	......	....	....	Well was recased in 1962.
1daa1	1942	524	18	....	160-500	1,298	N	142 R 221.8	3/42 2/66	.....	.....	....	......	....	....	
1daa2	1962	511	12	511	300-500	1,298	D	197 R	3/62	.....	.....	....	......	....	....	
1dda	1946	506	20	506	130-490	1,295	PS	115 R	5/46	.....	.....	....	......	....	....	
2cbb	1963	695	8	666	200-620 OH 666-695	1,295	D	310 R	9/64	X	.....	....	......	....	....	
2ccc	....	700	12-10	....	....	1,299	I	....	....	.....	.....	400 R	......	....	....	

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level: Depth below land surface (feet)	Water level: Date measured (month, year)	Log	Chemical analysis	Pumping data: Yield (gpm)	Pumping data: Drawdown (feet)	Pumping data: Date measured (month, year)	Specific capacity (gallons per minute per foot of drawdown)	Remarks
(A-2-4)3cdd	1961	439	8	439	....	1,314	D	266 R 382 R	9/58 7/64	.....	.....	....	......	....	....	Granite at 400 feet reported by driller.
3dad	1945	500	....	....	....	1,296	PS	202.8	9/66	.....	.....	....	......	....	....	
10bcd	1945	530	....	....	....	1,330	I	300 R	7/65	.....	.....	360 R	......	7/54	....	
10cab1	1957	1,396	20-16	1,155	540-1,155 OH 1,155-1,396	1,328	PS	380 R 402 R	2/66 9/66	.....	X	....	......	....	....	
10cab2	1956	972	20-16	856	410-856 OH 856-972	1,335	PS	385 R 406 R	2/66 9/66	.....	X	....	......	....	....	
10cbd	1954	737	16	408	250-382 OH 408-737	1,338	N	182 R	4/54	X	.....	....	......	....	....	
11bad	1948	280	16	195	92-142 OH 195-280	1,281	I	92 R	5/48	.....	.....	....	......	....	....	Probably has been deepened.
11cbc	1959	918	12	918	384-918	1,298	I	345.0	2/66	X	X	....	......	....	....	
11dbc	1962	1,300	24-20	1,281	500-1,265	1,278	PS	322 R	2/66	.....	X	....	......	....	....	
11dcb	1959	1,372	20-16	1,343	500-1,343 OH 1,343-1,372	1,278	PS	322 R	2/66	.....	X	....	......	....	....	
11dcc1	1957	1,003	20	1,000	348-996 OH 1,000-1,003	1,275	I	214 R 332.2 S	5/57 2/66	X	X	3,218 S	33	3/57	96	
11dcc2	1965	1,743	20-8	1,725	700-1,732 OH 1,732-1,743	1,278	PS	324 R	2/66	.....	.....	3,300 R	......	2/65	....	Electric log; lithologic log, 300-1,740 feet.
12aad	1965	700	12-10	700	175-700	1,284	I	175 R	3/65	.....	.....	450 R	51	3/65	9	
12bbc	1962	1,100	20	800	400-785 OH 800-1,100	1,276	I	320.4	2/66	X	.....	....	......	....	....	
12bdd	1957	1,000	20	996	348-996 OH 996-1,000	1,281	I	204 S 320.4	3/57 2/66	.....	X	2,936 2,450	57 62	3/57 8/64	52 40	Recovery test, 1964; T = 180,000.
12daa	1949 1953	544 1,200	24 24-20	442 1,200	185-435 140-1,188	1,281	I	152 R 290.6 S	7/53 2/66	X	X	1,000 R 950 R	65 67	5/49 7/53	15 14	
12ddd	1965	1,481	20-16	1,481	697-1,400	1,274	PS	298 R	2/66	.....	.....	2,000 R	58	6/65	34	
13caa	1952	1,020	20-16	1,020	800-1,004	1,264	I	102 R 304.6 S	4/52 2/66	.....	X	2,430 R 2,160	68 77	4/52 8/66	35 28	Drawdown test, 1966; T = 160,000.
13daa	....	1,210	20-16	1,210	465-1,210	....	PS	285 R	2/66	.....	.....	....	......	....	....	
14acb	1960	726	16	713	300-700 OH 713-726	1,278	D	220 R 300 R	6/60 10/60	.....	.....	900 R	106	10/60	8	
14cbb	1927 1950 1957	207 410 840	20 12	207 646	75-200 330-640 OH 646-840	1,299	I	120 R	5/46	.....	.....	1,250 R	40	5/46	31	

Table 1.--Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level: Depth below land surface (feet)	Water level: Date measured (month, year)	Log	Chemical analysis	Pumping data: Yield (gpm)	Pumping data: Drawdown (feet)	Pumping data: Date measured (month, year)	Specific capacity (gallons per minute per foot of drawdown)	Remarks
(A-2-4)14cdd	1956	960	20-16	776	350-540 550-760 OH 776-960	1,271	I	205.9S 299.5S	12/56 2/66	X	X	...	...	...	...	
15adb	...	601	...	...	...	1,313	I	314 R	8/64	...	...	...	...	...	...	
15dba	1946 1957	614 798	20	...	...	1,310	I	126 R	4/46	...	...	...	...	...	...	
16abb	1966	951	8	...	...	1,400	N	397	9/66	X	...	...	...	...	...	
21acc	1949	240	12-10	240	190-210	1,320	D	158 R	9/49	X	...	...	...	...	...	
22bdd	1955	567	20-16-12	567	370-567	1,290	I	198 R 387.1	12/55 9/66	...	...	...	...	...	...	
22dab1	1940 1956	317 703	20	...	...	1,275	I	159 R 223 R 390 R	9/54 7/56 8/66	X	...	...	...	...	...	
22dab2	1958	704	20	700	425-690 OH 700-704	1,275	I	155 R 391 R	4/58 8/66	...	...	...	...	...	...	
22dab3	1939 1956	320 610	20 16	... 601	... 310-595 OH 601-610	1,275	I	190 R 165 R 174.8R	/39 1/56 3/56	...	...	1,605R	26	3/56	62	
22dba	1951 1957	465 643	20	...	...	1,278	I	...	...	...	...	...	...	...	...	
22dbb	1950 1956	458 655	20 16	... 655	... 238-631	1,282	I	140 R 231 R	5/50 5/56	...	...	...	...	...	...	
22dcc	1955	630	20	590	300-576 OH 590-630	1,268	I	187 R 336.5S	12/55 2/66	...	X	1,555	40	7/66	39	Recovery test in 1966; T = 130,000.
23bcc	1954	780	20	770	300-750 OH 770-780	1,270	I	126 R 339.8S	10/54 2/66	...	X	...	...	...	...	
23ddd	1959	1,200	20	1,200	350-1,188	1,236	PS	138 R 265 S	4/59 2/66	X	X	1,510R	23	5/59	66	
24bad	1949 1953	490 1,300	24 20	... 1,012	190-444 460-1,012 OH 1,012-1,300	1,252	I	90 R 118 R 297.4S	1/49 8/53 2/66	X	X	1,500 2,950 2,190	35 45 59	1/49 8/53 7/66	43 66 37	Drawdown test in 1966; T = 96,000.
24cab	1960	1,265	20-16	1,265	500-1,260	1,248	PS	285 R	2/66	...	...	...	...	...	...	
24dbd	1959	1,250	12-10	1,250	250-1,250	1,246	PS	285 R	2/66	...	...	...	...	...	...	
25aaa	1958	1,200	20	1,200	320-1,180	1,243	PS	193 R 287 R	4/58 2/66	...	X	1,400R	35	4/58	40	
25aab	1965	1,325	20	1,296	350-1,275 OH 1,296-1,325	1,243	PS	287 P	2/66	X	X	1,550R	35	3/65	44	
25abb	1959	1,200	20	1,200	350-1,188	1,243	PS	298 P	2/66	...	X	...	...	...	...	

Table 1. --Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level: Depth below land surface (feet)	Water level: Date measured (month, year)	Log	Chemical analysis	Pumping data: Yield (gpm)	Pumping data: Drawdown (feet)	Pumping data: Date measured (month, year)	Specific capacity (gallons per minute per foot of drawdown)	Remarks
(A-2-4)25bcd	1949 1953	550 1,295	20 16	 1,295	100-458 475-1,205	1,235	I	85 R 138 R 308.3 S	11/49 11/53 2/66	X	X	1,580 R 1,555	61 52	9/49 7/66	26 30	Drawdown test in 1966; T = 130,000.
25cdb	1957	1,300	20-16	1,300	300-692 705-1,288	1,228	I	129 R 269.6 S	12/57 2/66	....	......	....	.....	....	....	
25cdd	1950 1960	500 1,200	20 16	 1,200	100-480 500-1,185	1,225	PS	80 R 241 R 278 P	5/50 5/60 2/66	X	X	2,500 3,650	58 37	5/50 5/60	43 99	
25dca	1950 1958	500 1,205	20-16 14	 1,200	100-492 500-1,190 OH 1,200-1,205	1,228	PS	77 R 156.6 279 P	4/50 4/58 2/66	....	X	2,285 R 1,565 R	81 22	4/50 4/58	28 71	
27bcb	1956	800	20-18	792	238-792 OH 792-800	1,270	PS	182.2	12/56	X	......	....	.....	....	....	
28bda	1957	371	20	330	210-310 OH 330-371	1,265	N	162 R	5/57	....	......	....	.....	....	....	Abandoned.
33aaa	1958	350	20	....	200-260	1,270	N	200 R	3/58	X	......	....	.....	....	....	Do.
35aab	1958	985	20	985	200-970	1,220	PS	140 R 272 P	3/58 2/66	X	X	1,400 R	24	5/58	58	
35abb	1951 1958	500 1,000	20 16	500 1,000	140-485 500-990	1,229	PS	90 R 170 R 275 P	7/51 7/58 2/66	....	X	....	.....	....	....	
35bba	1941	250	20	....	75-235	1,231	I	55 R 140.7 S	3/41 2/66	....	X	492 S	.....	8/65	....	
35dcc	1952	660	20	660	135-640	1,208	I	75 R 257 S	11/52 2/66	....	X	1,800	49	7/66	37	
(A-2-5)6acb	1959	500	16	500	200-490	1,308	I	193.3	6/59	....	X	601	.....	8/66	....	
7dda	1950 1963	748 1,220	20-16 12	732 1,220	 209-1,200	1,284	I	160 R 255 R 290.1	10/50 2/63 9/66	X	......	980 R 2,130 R 1,800 R	....	12/62 3/63 8/64	....	
10ddd	1960	550	12	550	375-540	1,328	D	276 R 328.2	11/60 9/66	....	......	....	.....	....	....	
15aaa	1951	658	20	642	275-630 OH 642-658	1,328	I	171 R 340 R	2/51 1/66	....	X	1,800 R 2,620	....	2/51 9/66	....	Intermittently perforated
15daa	1951 1962	597 1,100	20 16	500 1,100	246-1,090	1,312	I	159 R 277 R 311.4	4/51 1/62 1/66	X	......	3,080 R 2,880 R	....	1/62 8/64	....	Do.
16aaa	1952 1962	575 1,055	20 16	512 1,055	225-500 515-1,050	1,307	I	156 R 257 R 292.5	3/52 2/62 8/66	X	X	2,800 R 2,900	29	9/63 7/66	97	
16caa	1948	493	....	....	....	1,285	I	....	....	....	......	1,900	.....	9/66	....	

Table 1. --Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level		Log	Chemical analysis	Pumping data			Specific capacity (gallons per minute per foot of drawdown)	Remarks
								Depth below land surface (feet)	Date measured (month, year)			Yield (gpm)	Draw-down (feet)	Date measured (month, year)		
(A-2-5)16dda	....	342	....	....	....	1,288	N	259.4	11/65	......	......	....	.....	....	....	Abandoned.
17aad	1948	494	....	....	....	1,287	I	261.1	9/66	......	......	2,250 R	.....	11/61	....	
19aaa	1948	310	20	304	90-295 OH 304-310	1,262	N	85 R 181.1	4/48 1/66	......	......	....	.....	....	....	Do.
19aba	1958	1,106	20	984	450-984 OH 984-1,106	1,259	I	200 R 306.6	5/58 7/66	......	X	2,010	72	7/66	28	Drawdown test in 1966; T = 62,000.
30dbc	1958	600	20	600	275-586	1,238	I	143 R 276.7 R	9/58 1/66	X	......	....	.....	....	....	
(A-3-3)1ccc	....	300	8	....	....	1,431	N	183.1 212.6	10/45 2/62	......	......	....	.....	....	....	Dry in 1963.
2bcc1	....	246	8	246	....	1,424	N	176.7 227.7	11/47 2/64	......	......	....	.....	....	....	Dry in 1966.
2bcc2	....	246	8	....	....	1,424	N	180 R 244.5	9/44 9/66	......	......	....	.....	....	....	Abandoned.
3aba	1944	297	8	....	....	1,426	N	187 R 249.3	4/46 2/66	......	......	....	.....	....	....	
3aca1	....	....	....	....	....	1,422	D	....	....	......	......	....	.....	....	....	
3aca2	....	375	....	....	....	1,422	D	234.5	9/66	......	......	....	.....	....	....	
3acc1	1940	191	6	15	OH 15-191	1,418	D	170 R	3/41	......	......	....	.....	....	....	
3acc2	1939	190	6	....	....	1,418	D	174 R	3/41	......	......	....	.....	....	....	
3acc3	 1965	261 296	....	....	....	1,418	D	....	....	......	......	....	.....	....	....	
3add1	....	270	....	....	....	1,424	PS	180 R	4/46	......	......	....	.....	....	....	
3add2	....	....	....	....	....	1,424	PS	....	....	......	......	....	.....	....	....	
6baa	1948	880	20	702	300-702 OH 702-880	1,360	D	269.2	12/48	X	......	....	.....	....	....	
7abd	1946	569	16	500	....	1,360	N	269.1	2/66	X	......	....	.....	....	....	Do.
13add	1964	410	20-12	409	....	1,398	N	282.7	2/66	X	......	125 R	.....	1/65	....	Capped, July 1966.
13bdb1	1959	350	12	297	187-297 OH 297-350	1,400	PS	190 R	2/59	......	......	....	.....	....	....	
13bdb2	1960 1966	330 405	12 10	 400	190-400 OH 400-405	1,400	PS	203 R 244 R	2/60 2/66	......	X	190 R 460 R	42 35	4/60 1/66	4 13	
13bdd1	1948	304	10	304	180-304	1,398	PS	152 R 251 R	3/48 8/65	......	......	....	.....	....	....	
13bdd2	1953	292	13-10	292	140-292	1,398	PS	....	....	......	......	....	.....	....	....	

Table 1.--Records of selected wells in Paradise Valley—Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level		Log	Chemical analysis	Pumping data			Specific capacity (gallons per minute per foot of drawdown)	Remarks
								Depth below land surface (feet)	Date measured (month, year)			Yield (gpm)	Drawdown (feet)	Date measured (month, year)		
(A-3-3)14cab	...	320	4	...	...	1,440	N	190 R 236.4	10/45 2/66	...	...	...	...	...	...	Annual observation well.
(A-3-4)2baa1	1950	1,585	20-12	1,100	300-1,100 OH 1,100-1,585	1,527	N	273.3 301.7	1/52 2/66	...	...	1,200 R	120	6/50	10	Do.
2baa2	1948	4,159	...	...	...	1,527	N	...	...	X	...	...	...	...	...	Oil-test hole; samples to 4,000 feet; lithologic log; plugged at 232 feet.
2cca	...	415	6	415	265-415	1,481	D	...	...	...	...	...	...	...	...	
4cba	1966	803	10	803	404-803	1,470	D, I	250 R	7/66	X	...	125	...	9/66	...	
5cad	...	...	...	...	...	1,455	N	259.4	9/66	...	...	...	...	...	...	Abandoned.
5ccd1	...	...	...	...	...	1,445	D	...	...	...	...	...	...	...	...	
5ccd2	...	...	...	...	...	1,445	D	...	...	...	...	...	...	...	...	
6aaa	...	350	6	...	...	1,477	D	240 R	9/45	...	...	25 R	...	9/45	...	
6bba1	...	1,150	16	1,150	...	1,468	PS	287 R	7/66	...	...	300 R	58	7/66	5	
6bba2	...	950	16	950	...	1,463	PS	269 R	3/62	...	...	200 R	...	7/66	...	
6ccd	...	1,140	16-10	1,140	...	1,440	PS	214 R 287 R	3/62 7/66	...	X	530 R	...	7/66	...	
6dcc	1930	318	6	...	...	1,441	D	210 R 244.1	4/46 9/66	...	...	...	...	...	...	
7bcb	...	...	8	...	...	1,430	D	264.4	9/66	...	...	...	...	...	...	
8dda	1957	600	...	...	...	1,425	D	...	...	...	...	...	...	...	...	
9ccc	...	200	...	...	...	1,417	D	184 R	3/46	...	...	...	...	...	...	Probably has been deepened.
11cba	1954	1,200	20	1,200	219-1,185	1,448	D	222 R 226 R	1/56 2/66	...	...	480 R	153	1/56	3	Well capped.
12cda	1952	500	12	500	250-500	1,445	N	250 R	5/52	...	...	400 R	50	7/53	8	Abandoned.
14baa	1942	800	12	750	200-750 OH 750-800	1,425	D	...	...	...	...	...	...	...	...	
14bba	1942	507	12	507	200-485	1,425	D	...	...	...	...	...	...	...	...	
15ada	1954	300	8	300	...	1,410	D	194.5	9/66	...	...	...	...	...	...	
15add	...	310	...	...	...	1,408	D	...	...	...	...	...	...	...	...	
17aaa	1951	906	20	906	290-350 375-885	1,415	N	180 R 269.9	12/51 2/66	X	...	...	...	...	...	
17baa	1952	981	20	917	440-917	1,414	I	306.9 R	1/66	...	...	...	...	...	...	

Table 1.--Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level		Log	Chemical analysis	Pumping data			Specific capacity (gallons per minute per foot of drawdown)	Remarks
								Depth below land surface (feet)	Date measured (month, year)			Yield (gpm)	Draw-down (feet)	Date measured (month, year)		
(A-3-4)21aba	1952	820	12-10	500	160-500 OH 500-820	1,387	N	160 R 298.2	8/52 8/66	.....	.....	500 R	80	7/53	6	
21abd	....	800	....	....	....	1,380	D	....	....	.....	.....	....	......	....	....	
21ada	1965	1,119	6	1,044	1,024-1,044 OH 1,044-1,119	1,378	Ind	184 R	5/65	.....	.....	....	......	....	....	
21baa	1957	1,045	16	1,008	336-1,008 OH 1,008-1,045	1,384	I	205 R 332.2	2/57 8/66	X	X	1,890 R 1,227	66 40	2/57 8/66	29 31	
21ccb	1961	1,050	12-10	1,010	300-1,005 OH 1,010-1,050	1,363	PS	232 R 280 R	1/62 2/66	.....	X	....	......	....	....	
21ccc	1966	1,100	16	1,100	370-1,088	1,363	PS	268 R	4/66	X	.....	....	......	....	....	
21dda	....	......	....	....	....	1,360	D	....	....	.....	.....	....	......	....	....	
22aca	....	1,200	12	....	....	1,376	PS	280 R	3/65	.....	X	....	......	....	....	
23acd	1953	600	12	596	285-585 OH 596-600	1,371	PS	235 R	3/66	.....	X	....	......	....	....	
23bcd	1940 1955	320 580	8-6	 550	....	1,374	PS	160 R 286	8/46 2/66	.....	X	....	......	....	....	
23daa	1950	623	12	623	225-608	1,371	D	170 R 231.5	8/50 8/66	.....	.....	....	......	....	....	
23dad	1963	909	16	909	350-900	1,366	I	210 R	7/63	X	.....	650 R	160	7/63	4	
24bcd	1954	890	16-12	890	....	1,370	I	205 R	2/54	.....	.....	600 R	170	2/54	4	
24bdb	1950	715	12	705	225-700 OH 705-715	1,380	D, S	195 R	3/50	.....	.....	800 R	59	4/51	14	
24caa	1950	700	20	700	220-700	1,380	PS	205.2 233.2	2/57 2/66	.....	X	125 R	......	4/52	....	
25aba	1947	472	12	328	160-300 OH 328-472	1,365	D	160 R 245.1	6/47 8/66	.....	.....	500 R 522	....	6/47 6/49	....	
25dbb	....	389	8	389	....	1,350	D	256 R	7/65	.....	.....	....	......	....	....	
26aac	....	......	....	....	....	1,348	D	....	....	.....	.....	....	......	....	....	
26aad	....	......	....	....	....	1,345	D	213.1	9/66	.....	.....	....	......	....	....	
26cbb	1953	485	20	238	185-220 OH 238-485	1,335	I	170 R 210.3	7/53 8/66	.....	.....	60 R	......	8/66	....	
27bba	1956	980	12	980	370-980	1,353	PS	230 R	2/66	.....	X	80 R	......	9/66	....	
27ccd	1951	300	6	300	145-300	1,326	PS	162.5	9/66	.....	.....	....	......	....	....	
27dda	1959	438	8	408	174-408 OH 408-438	1,325	PS	....	....	.....	.....	....	......	....	....	

Table 1. --Records of selected wells in Paradise Valley—Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level: Depth below land surface (feet)	Water level: Date measured (month, year)	Log	Chemical analysis	Pumping data: Yield (gpm)	Pumping data: Drawdown (feet)	Pumping data: Date measured (month, year)	Specific capacity (gallons per minute per foot of drawdown)	Remarks
(A-3-4)27ddd	1947	300	8	300	180-300	1, 323	PS	....	....	.....	X	....	......	....	....	
29aaa	1948 1949	541 894	12 8	 831	250-536 OH 831-894	1, 358	I	137 R 290 R	8/49 1/66	.....	.....	650 R	40	8/49	16	
29dcd	1960	875	12-8	875	374-875	1, 348	PS	226 R	2/66	X	X	350	......	9/66	....	
33caa	1955 1964	425 600	12	600	....	1, 332	PS	280 R	2/66	X	.....	....	......	....	....	
33daa	1966	865	16	653	375-645 OH 653-865	1, 322	I	271 R	1/66	.....	.....	1, 500 R	63	1/66	24	
33dad1	1950	600	8	......	....	1, 320	D, S	....	....	.....	.....	....	......	....	....	
33dad2	1951	652	8	652	230-640	1, 323	D, S	190 245	3/51 9/65	.....	.....	....	......	....	....	
34ada	1947	400	12	400	170-400	1, 317	PS	128 R 178 R	6/52 /66	.....	X	....	......	....	....	
34bdb	1951 1959	329 727	12 8-6	 727	140-329 6[illegible]0-727	1, 316	N	145 R 174 R 198. 6	5/51 3/59 9/66	.....	.....	....	......	....	....	Abandoned.
34daa	1952	300	12	300	150-300	1, 318	I	119 R	1/52	.....	.....	250 R	90	1/52	3	
34dba	1951 1954	300 885	12 8	 868	140-300 400-868 OH 868-885	1, 309	N	140 R 128 R	11/51 3/54	.....	.....	510 R 500 R	45 80	11/51 3/54	11 6	Do.
34dbb	1951	300	12	300	150-300	1, 309	N	....	....	.....	.....	....	......	....	....	
34dda	1951 1954	300 912	12 8	 912	1[illegible]0-300 312-912	1, 304	N	135. 0 193. 2	1/52 2/66	X	.....	500 R 500 R	35 88	11/51 7/54	14 6	Do.
35ada	1950	1, 000	20	950	1[illegible]6-930 OH 950-1, 000	1, 324	I	154 R 300. 2	8/50 9/66	X	.....	....	......	....	....	
35bac	1954	400	16	312	1[illegible]5-306 OH 312-400	1, 318	I	168 R 186. 9	7/54 8/66	.....	.....	450 R	112	7/54	4	
35bbb	1948	452	20-16	452	1[illegible]0-452	1, 323	I	150. 7 188. 9	1/52 8/66	.....	.....	....	......	....	....	
35cbb	1941	564	20	......	....	1, 309	I	193. 9	8/66	.....	.....	....	......	....	....	
35ddd	1961	851	16	851	3[illegible]1-851	1, 307	I	276 R	3/64	.....	.....	....	......	....	....	
36aad	....	780	8-6	700	4[illegible]0-700 OH 7[illegible]0-780	1, 330	D	207 R	9/61	.....	.....	....	......	....	....	
(A-3-5)16acc1	1938	380	6	......	....	1, 565	N	316 R	5/46	.....	.....	....	......	....	....	
16acc2	1964	550	12	527	4[illegible]5-525 OH 5[illegible]7-550	1, 565	D	340 R	6/64	X	.....	....	......	....	....	
17cca	1955	430	6	430	....	1, 420	D	190 R	8/55	.....	.....	....	......	....	....	

Table 1.--Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level: Depth below land surface (feet)	Water level: Date measured (month, year)	Log	Chemical analysis	Pumping data: Yield (gpm)	Pumping data: Draw-down (feet)	Pumping data: Date measured (month, year)	Specific capacity (gallons per minute per foot of drawdown)	Remarks
(A-3-5)17dcc1	...	...	8	...	...	1,423	D, I	240 R	2/60	...	...	...	...	...	...	
17dcc2	...	980	8	975	OH 975-980	1,423	D, I	240 R	4/59	...	...	160	...	4/59	...	
18cab	1952	550	8	...	...	1,423	D	217.9 229.1	10/52 1/58	...	...	...	...	...	...	
18ccc	1965	650	10-8	650	610-620	1,405	D	300 R 280.7	1/66 8/66	...	...	...	...	...	...	
18ccd	...	270	...	...	...	1,407	D	204.6	1/52	...	...	...	...	...	...	
18ddd	...	430	6	...	...	1,408	D	...	...	...	...	...	...	...	...	
19aba	1947	500	12	...	...	1,408	D	290	8/66	...	...	...	...	...	...	
19adb1	1952	610	16	523	250-510 OH 523-610	1,396	N	210 R	2/52	X	...	230	...	2/52	...	Filled.
19adb2	1952	1,158	...	...	...	1,396	I	314.6	8/66	...	X	500	...	8/66	...	
20bbb1	1965	900	...	...	...	1,408	D	284.8	8/66	...	...	...	...	...	...	
20bbb2	1966	500	...	...	...	1,412	D	294.9	8/66	...	...	...	...	...	...	
21bba	1962	480	8	460	...	1,435	D	240	8/66	...	...	...	...	...	...	
21bcd	1964	355	5	355	230-350	1,408	D	235 R	4/64	...	...	...	...	...	...	
25cab	1963	705	8	...	...	1,555	D	450 R 449.7	/63 8/66	...	...	10R	...	/63	...	
26ccd	1966	800	12	800	525-796	1,470	D	343.3	8/66	X	X	240R	148	5/66	2	
27bba	...	...	...	...	...	1,435	D	...	...	...	...	...	...	...	...	
28acd	...	...	...	...	...	1,403	D	...	...	...	...	...	...	...	...	
28adc	1966	405	...	...	...	1,410	D	351 R	8/66	...	...	...	...	...	...	
(A-4-3)3cbb	1946	36	3 x 6 ft	...	...	1,575	N	27.7 29.7	1/47 2/66	...	...	...	...	...	...	Abandoned.
15ccb	...	280	6	...	...	1,500	N	268.1 Dry	2/66 9/66	...	...	...	...	...	...	
22aca1	...	375	...	...	...	1,538	N	306.6	9/66	...	...	...	...	...	...	
22aca2	...	375	...	...	...	1,538	D	...	...	...	...	...	...	...	...	
22aca3	...	375	...	...	...	1,538	D	...	...	...	...	...	...	...	...	
23caa	...	...	...	...	...	1,515	D	...	...	...	...	...	...	...	...	
23cab	...	...	...	...	...	1,516	D	...	...	...	...	...	...	...	...	
23dba1	1958	317	...	...	...	1,522	D	200 R	8/66	...	...	...	...	...	...	

Table 1.--Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level		Log	Chemical analysis	Pumping data			Specific capacity (gallons per minute per foot of drawdown)	Remarks
								Depth below land surface (feet)	Date measured (month, year)			Yield (gpm)	Drawdown (feet)	Date measured (month, year)		
(A-4-3)23dba2	....	....	....	....	....	1, 520	D	....	....	.....	.....	....	.....	....	....	
26cba	1964	340	12	340	275-328	1, 490	D	260 R	10/64	X	.....	....	.....	....	....	
26dba1	....	....	....	....	....	1, 485	D	....	....	.....	.....	....	.....	....	....	
26dba2	1957	300	....	....	....	1, 482	D	262. 1	9/66	.....	.....	....	.....	....	....	
26dbb1	....	....	....	....	....	1, 482	D	....	....	.....	.....	....	.....	....	....	
26dbb2	....	....	....	....	....	1, 482	D	....	....	.....	.....	....	.....	....	....	
26dbb3	....	....	....	....	....	1, 481	D	....	....	.....	.....	....	.....	....	....	
26dcd	....	....	....	....	....	1, 475	D	....	....	.....	.....	....	.....	....	....	
34aad	1957	270	8	250	230-250 OH 250-270	1, 459	N	245. 7	9/66	.....	.....	....	.....	....	....	Abandoned.
34abb	1957	280	8	....	....	1, 455	D	238 R	7/66	.....	.....	....	.....	....	....	
35daa1	....	680	12-10	680	....	1, 462	N	225 R	3/62	.....	.....	125 R	.....	3/62	....	
35daa2	....	580	12	580	....	1, 462	PS	225 R	3/62	.....	.....	16 R	.....	9/66	....	
(A-4-4)8cdc	1951	5, 396	12	....	....	1, 700	N	434. 0 448. 5	1/52 9/66	.....	.....	....	.....	....	....	Sample depth, 415-4, 520. Abandoned.
10ccb	1964	690	6	620	OH 620-690	1, 810	D	560 R	7/64	X	X	14 R	.....	6/64	....	
11cac	1955	671	8	....	....	1, 880	N	630	1/58	.....	.....	....	.....	....	....	
13aab1	....	....	8	....	....	1, 955	D	695. 0	2/52	.....	.....	....	.....	....	....	
13aab2	1950	664	12	664	480-664	1, 950	N	625	9/66	.....	.....	....	.....	....	....	
13cbb	1950	1, 585	10	550	OH 550-1, 585	1, 854	N	425 R	7/50	X	.....	....	.....	....	....	
17ccc	....	520	6	....	....	1, 625	D, S	336 R	3/65	.....	.....	....	.....	....	....	
29aaa	....	521	6	....	....	1, 590	D, S	341. 8	9/66	.....	.....	....	.....	....	....	
30cbb	....	300	6	....	....	1, 522	D, S	....	....	.....	.....	....	.....	....	....	
30cdb	1962	1, 088	16	1, 088	800-1, 088	1, 512	PS	275 R 285 R	3/62 8/62	.....	.....	....	.....	....	....	
31ccd	....	600	....	....	....	1, 470	D	....	....	.....	.....	....	.....	....	....	
31ddd	....	300	6	....	....	1, 481	D	235 R	10/52	.....	.....	....	.....	....	....	
32bad	1952	1, 214	20-18-12	1, 185	270-1, 185 OH 1, 185-1, 214	1, 522	N	260 R 293. 2	8/52 2/66	X	.....	1, 500 R	130	8/52	12	
32cda	1952	1, 331	20-12	1, 160	270-1, 160 OH 1, 160-1, 331	1, 492	D, S	252 R 288. 0	6/52 2/66	.....	.....	1, 500 R	130	6/52	12	

Table 1.--Records of selected wells in Paradise Valley——Continued

Well number	Date completed (year)	Depth of well (feet)	Diameter of casing (inches)	Depth of casing (feet)	Perforated interval (feet below land surface)	Land-surface altitude (feet above mean sea level)	Use of water	Water level		Log	Chemical analysis	Pumping data			Specific capacity (gallons per minute per foot of drawdown)	Remarks
								Depth below land surface (feet)	Date measured (month, year)			Yield (gpm.)	Draw-down (feet)	Date measured (month, year)		
(A-4-4)34aaa	1965	950	16	950	650-934	1, 584	N	341. 5	8/66	.....	.....	....	......	....	....	Lithologic log.
(A-5-3)14bab	....	1, 136	....	....	....	....	N	....	....	X	.....	....	......	....	....	Oil-test hole.
(A-5-4)1aaa	1949	250	8	....	....	2, 555	S	180 R	/66	.....	.....	....	......	....	....	
1acb	....	....	8	....	....	2, 500	S	102. 4	5/62	.....	.....	....	......	....	....	
1cca1	....	277	....	....	....	2, 440	N	....	....	.....	.....	....	......	....	....	Abandoned.
1cca2	....	....	....	....	....	2, 440	N	20. 5	9/66	.....	.....	....	......	....	....	Do.
3cdd1	1959	215	....	....	....	2, 230	D	150 R	9/66	.....	.....	....	......	....	....	
3cdd2	....	150	....	....	....	2, 240	N	135 R	/65	.....	.....	....	......	....	....	
3cdd3	....	198	....	....	....	2, 240	D	150 R	9/66	.....	.....	....	......	....	....	
3dcc1	1945	310	4	....	....	2, 230	D, S	....	....	.....	.....	....	......	....	....	
3dcc2	1950	320	6	....	....	2, 230	D	....	....	.....	.....	....	......	....	....	
3ddc	....	23	....	....	....	2, 269	N	18	9/66	.....	.....	....	......	....	....	Do.
5dcc	1966	870	8	850	800-850	2, 000	D, S	698	3/66	.....	X	....	......	....	....	
7aad1	....	....	....	....	....	1, 945	D	670 R	6/46	.....	.....	....	......	....	....	
7aad2	....	1, 030	....	....	....	1, 931	N	....	....	X	.....	....	......	....	....	Oil-test hole converted to water well; sample depth, 398-1, 040.
8dbd	1965	1, 100	10	1, 100	800-1, 090	2, 020	N	741. 1	3/66	.....	X	500 R	56	1/66	9	
21dcc	....	....	....	....	....	2, 045	D, S	....	....	.....	.....	....	......	....	....	
25dbd	....	....	6	....	....	2, 250	N	293. 0	9/66	.....	.....	....	......	....	....	
28bbb	1960	865	6	....	....	1, 978	I	730 R	11/60	.....	.....	....	......	....	....	
33daa	1962	993	6	967	....	1, 972	D, I	730 R	5/62	X	X	....	......	....	....	

Table 2. --Modified drillers' logs of selected wells in Paradise Valley

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-1-4)1aba		
Upper alluvium	Clay	15	15
	Sand, gravel, and clay	88	103
Middle alluvium	Tight gravel	17	120
	Clay	22	142
	Gravel and fine sand	7	149
	Clay	8	157
	Fine sand and gravel—1 inch	3	160
	Hard caliche clay	43	203
	Sand, clay, and gravel—1 inch	7	210
	Hard clay	27	237
	Sand, clay, and gravel	11	248
	Hard red clay	92	340
	Hard clay and gravel	28	368
	Caliche	91	459
	Caliche and gravel	6	465
	Caliche	25	490
Red(?) unit	Red rock	3	493
	TOTAL DEPTH		493

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-1-4)1cda		
Upper alluvium	Topsoil	5	5
	Sand, gravel, and boulders	2	7
	Soil	5	12
	Soft clay	14	26
	Clay and boulders	24	50
	Sand, gravel, and boulders	66	116
Middle alluvium	Clay and gravel	57	173
	Sticky clay	19	192
	Hard clay and caliche	80	272
	Clay and some gravel	113	385
	Hard and sticky clay	219	604
	Caliche and gravel	31	635
	Clay, caliche, and boulders	115	750
Lower alluvium	Cement boulders	60	810
	Sticky clay and cemented boulders	23	833
	Granite boulders	10	843
Red unit	Hard red clay and rock	7	850
	TOTAL DEPTH		850

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-1-4)2dbb		
Upper alluvium	Soil	5	5
	Caliche clay	18	23
	Tight gravel	7	30
	Sand, gravel, and boulders	124	154
Middle alluvium	Sticky clay	56	210
	Silty clay	10	220
	Sandy gravelly clay	20	240
	Tough clay	25	265
	Packed sand and gravel	5	270
	Coarse sand and some gravel	40	310
	Tough gravelly clay	80	390
	Soft sandy clay and some gravel	50	440
	Clay and gravel	28	468
	Cemented mountain wash	3	471
	Hard packed sand	14	485
	Cemented mountain wash	12	497
	Silty clay	11	508
	Clay and gravel	12	520
Red(?) unit	Cemented mountain wash	15	535
	Cemented granite fill	75	610
	TOTAL DEPTH		610

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-1-4)11acd		
Upper alluvium	Soil	6	6
	Caliche clay	12	18
	Sand, gravel, and boulders	116	134
Middle alluvium	Clay, brown	26	160
	Sandy clay	25	185
	Silty clay, yellow	65	250
	Clay and gravel	15	265
	Sticky clay and silt	20	285
	Packed silt and cemented shells	75	360
	Cemented gravel	12	372
	Shale, brown	3	375
	Tough sticky clay with shale streaks	45	420
	Shale	3	423
	Clay and gravel, 3/4 inch	49	472
Red(?) unit	Cemented mountain wash	73	545
	TOTAL DEPTH		545

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-1-4)11baa		
Upper alluvium	Topsoil	20	20
	Sand and boulders, water at 140	140	160
Middle alluvium	Sandy clay and gravel	115	275
	Cemented sand	45	320
	Sandy clay	225	545
Red unit	Conglomerate, red	505	1,050
	TOTAL DEPTH		1,050

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-1-5)6caa		
Upper alluvium	Silt and sand	18	18
	Coarse sand	18	36
	Boulder, sand gravel	144	180
Middle alluvium	Sandy clay (fine sand)	70	250
	Clay and gravel	25	275
	Coarse sand and gravel	35	310
	Clay and coarse sand	115	425
	Clay and gravel	85	510
	Coarse sand and gravel	70	580
	Clay	16	596
	TOTAL DEPTH		596

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-2-4)2cbb		
Upper alluvium	Sandy clay	125	125
	Loose gravel boulders	40	165
Middle alluvium	Clay with sand strips	85	250
	Clay	30	280
	Clay	80	360
	Clay with gravel in it	240	600
	Clay	20	620
	Clay with sand strips	30	650
	Hard clay	30	680
	Gravel, decomposed	....	....
Schist(?)	Mountain	....	695
	TOTAL DEPTH		695

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-2-4)10cbd		
Upper, middle, and lower alluvium	Topsoil	2	2
	Caliche	34	36
	Brown, sandy	16	52
	Caliche	8	60
	Sand and gravel	12	72
	Caliche	7	79
	Yellow sandy clay	47	126
	Brown sandy clay	89	215
	Brown clay and gravel	85	300
	Brown clay and boulders	83	383
Red(?) unit	Cemented boulders with streaks of red schist	354	737
	TOTAL DEPTH		737
	(A-2-4)11cbc		
Upper alluvium	Caliche	112	112
	Sand and boulders (river bed)	16	128
	Clay	8	136
	Sand and boulders	8	144
Middle alluvium	Clay	71	215
	No record	169	384
	Clay	126	510
	Coarse gravel	23	533
	Sand, gravel	26	559
	Sand, boulders, streaks	21	580
	Boulders	41	621
Lower(?) alluvium	Sand, hard streaks on boulders	31	652
	Cemented sand boulders	62	714
	Sand, boulders, streaks	81	795
Schist or red unit	Cemented sand	13	808
	Rock ledge	37	845
	Granite rock, hard	10	855
	Hard granite	20	875
	Solid rock formation	43	918
	TOTAL DEPTH		918
	(A-2-4)11dcc		
Upper alluvium	Soil	2	2
	Red sandy clay	33	35
	Coarse sand, gravel, and boulders	97	132
Middle alluvium	Clay and boulders	123	255
	Sandy clay, some rocks	25	280
	Clay	95	375
	Sandy clay, some rocks	100	475
	Coarse sand	11	486
	Clay and streaks of sand	196	682
	Sand, gravel, and some clay	83	765
Lower alluvium	Clay, cemented conglomerate streaks	15	780
	Cemented conglomerate	35	815
	Hard coarse sand and streaks of sand	111	926
	Hard sand and gravel	65	991
	Cemented sand and gravel, streaks of clay	12	1,003
	TOTAL DEPTH		1,003
	(A-2-4)12bbc		
Upper alluvium	Topsoil	3	3
	Caliche	47	50
	Sandy clay	30	80
	Clay and boulders	30	110
	Sand, clay, and boulders	40	150
	Clay and some gravel	58	208
Middle alluvium	Clay and caliche	496	704
Lower alluvium	Cemented conglomerate	396	1,100
	TOTAL DEPTH		1,100

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-2-4)12daa		
Upper alluvium	Boulders	5	5
	Caliche clay	67	72
	Boulders	74	146
Middle alluvium	Soft sandy clay	8	154
	Tough clay, red	16	170
	Hard packed silt	45	215
	Sandy clay, sticky	17	232
	Sandy clay	18	250
	Packed silt, cemented	35	285
	Sticky sandy clay	30	315
	Sandy clay	30	345
	Sandy clay, hard streaks	30	375
	Packed silt	40	415
	Packed silt, cemented streaks	30	445
	Sticky clay	15	460
	Sandy clay	50	510
	Packed silt, cemented streaks	15	525
	Cemented sand	3	528
	Packed silt, cemented streaks	16	544
	Clay, sandy, gravel streaks	101	645
	Sticky clay	265	910
	Sandy clay and gravel	30	940
	Cemented gravel	5	945
	Clay and gravel	205	1,150
	Dry white clay	50	1,200
	TOTAL DEPTH		1,200
	(A-2-4)14cdd		
Upper alluvium	Topsoil	2	2
	Caliche	56	58
	Brown clay	28	86
	Caliche and boulders	9	95
	Brown clay and boulders	45	140
	Sand and gravel	15	155
Middle alluvium	Red clay	40	195
	Brown clay	450	645
	Clay and gravel, 1/2 inch	13	658
	Brown clay	27	685
Lower alluvium	Conglomerate	55	740
	Tight clay and gravel, 1/4 inch	10	750
	Tight sand	15	765
Red(?) unit	Granite	35	800
	Cemented sand	20	820
	Conglomerate	30	850
	Granite	110	960
	TOTAL DEPTH		960
	(A-2-4)16abb		
Upper and middle alluvium	Decomposed granite	8	8
	Fill	221	229
Granite(?)	Hard granite	1	230
	Red granite	75	305
	Hard granite	7	312
	Granite	120	432
	Hard granite	20	452
	Granite (water 562 ft, about 3 gpm SWL = 399 ft)	119	571
	Granite	237	808
	Hard granite	6	814
	Granite	137	951
	(No more water from 562-951)		
	TOTAL DEPTH		951

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-2-4)21acc		
Upper and middle alluvium	Soil	30	30
	Caliche	90	120
	Sandy clay	55	175
	Gravel with some clay	7	182
	Sandy clay	30	212
Schist(?)	Mountain rock	28	240
	TOTAL DEPTH		240
	(A-2-4)22dab1		
Upper(?) alluvium	Soil	2	2
	Caliche	44	46
	Hard clay	15	61
	Hard shell	6	67
	Caliche	15	82
	Soft clay and silt	8	90
	Packed sand	14	104
	Boulders and gravel	39	143
Middle alluvium	Hard shell	6	149
	Cemented gravel	3	152
	Coarse gravel	12	164
	Cemented gravel and boulders	6	170
	Hard shell	10	180
	Clay and gravel	20	200
	Clay	39	239
	Gravel	3	242
	Clay	36	278
	Hard shell	3	281
	Sticky clay	24	305
	Decomposed granite	12	317
	Clay	72	389
	Hard shell	5	394
	Clay, sticky and sandy	39	433
	Hard shell	8	441
	Sandy sticky clay and thin shell	31	472
Red(?) unit	Hard decomposed granite	85	557
	Coarse rock or decomposed granite	6	563
	Hard shell	59	622
	Same stuff, but little softer	12	634
	Hard	29	663
	Coarser and some softer	4	667
	Hard	10	677
	Coarser and hard streaks	26	703
	TOTAL DEPTH		703
	(A-2-4)23ddd		
Upper alluvium	Topsoil	5	5
	Sand and gravel, 6 inches	170	175
Middle alluvium	Hard and soft streaks, sandy brown clay and gravel 1/2 inch	95	270
	Hard and sticky streaks, sandy brown clay and gravel 1/2 inch	480	750
Red(?) unit	Cemented sand and gravel $1\frac{1}{2}$ inches and sticky red clay streaks	145	895
	Sandy red clay and gravel to 8 inches	305	1,200
	TOTAL DEPTH		1,200

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-2-4)24bad		
Upper alluvium	Soil	12	12
	Clay and caliche shells	33	45
	Cemented sand and gravel, hard streaks	70	115
	Gravel, clay, and small boulders	30	145
Middle alluvium	Soft sandy clay and some gravel	35	180
	Clay, sticky	23	203
	Sandy clay with hard packed sand streaks	7	210
	Sandy clay, sticky	30	240
	Clay and hard streaks	20	260
	Sandy clay	22	282
	Gravel	5	287
	Sandy clay with pack sand shells, some gravel	58	345
	Sand rock	10	355
	Sandy clay, packed sand streaks	10	365
	Sandy clay, sticky	30	395
	Packed sand	25	420
	Silty clay, packed sand streaks	50	470
	Cemented coarse sand, some gravel	20	490
	Log of Deepening		
Middle(?) alluvium	Sand and brown clay (cleaned out)	14	470
	Sandy brown clay and embedded gravel, $1\frac{1}{2}$ inch	100	570
	Sand and gravel, 1/2 inch	3	573
	Sticky brown clay and embedded gravel, 1/2 inch	62	635
Lower alluvium and red(?) unit	Brown conglomerate	155	790
	Tight sand and gravel, clay	71	861
	Tight sand and gravel to 6 inches	89	950
	Hard sandy brown clay, embedded gravel to 4 inches	320	1,270
	Tight sand and gravel to 12 inches	30	1,300
	TOTAL DEPTH		1,300
	(A-2-4)25aab		
Upper alluvium	Topsoil	4	4
	Sandy clay	4	8
	Caliche	10	18
	Gravel and boulders	122	140
Middle alluvium	Sandy clay	130	270
	Clay and gravel up to 1 inch	25	295
	Gravel up to 1/2 inch	10	305
	Sandy clay	220	525
	Packed sand	15	540
Lower alluvium	Sandy clay, small streaks of sandstone	245	785
	Gravel, tight up to 4 inches	355	1,140
Red(?) unit	Conglomerate	80	1,220
	Packed sand and clay	70	1,290
	Conglomerate	35	1,325
	TOTAL DEPTH		1,325
	(A-2-4)25bcd		
Upper alluvium	Topsoil	14	14
	Limestone	12	26
	Sand boulders	134	160
Middle alluvium	Sandy clay	35	195
	Clay and caliche	115	310
	Gravel, 1/2 inch	15	325
	Clay, hard streaks	225	550
	Log of Deepening		
	Clay and gravel	80	550
	Sticky clay with hard shells	210	760
Red(?) unit	Hard red clay and rock	225	985
	Tight sand and gravel, boulders	165	1,150
	Red clay and rock	135	1,285
	Red sandy rock	10	1,295
	TOTAL DEPTH		1,295

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

(A-2-4)25cdd

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper alluvium	Topsoil	3	3
	Caliche and streaks of cemented sand and gravel	42	45
Middle alluvium	Clay and boulders	101	146
	Soft sticky clay and gravel	59	205
	Sticky clay	59	264
	Hard clay	48	312
	Clay and streaks of cement	33	345
	Clay	55	400
	Hard clay	100	500
	Hard gravel and clay	15	515
	Hard red clay	220	735
	Clay and gravel	60	795
Lower(?) alluvium	Decomposed granite	15	810
	Clay and gravel	55	865
	Decomposed granite, some boulders	280	1,145
Red unit	Hard red clay and rock hill formation	55	1,200
	TOTAL DEPTH		1,200

(A-2-4)27bcb

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	3	3
	Caliche and brown clay, 1/4 inch gravel	42	45
	Caliche	40	85
	Caliche and brown clay, 1/4 inch gravel	90	175
	Sticky brown clay and cemented streaks	40	215
	Cemented sand and gravel 1 inch sticky clay streaks	125	340
	Sticky brown clay, 1/2 inch gravel, and cemented streaks	115	455
	Cemented sand and gravel, 1/2 inch	20	475
	Sandy brown clay, embedded gravel to 4 inches	80	555
Red unit	Red clay, embedded granite boulders	25	580
	Conglomerate	15	595
	Green conglomerate	25	620
	Red conglomerate	15	635
	Black conglomerate	25	660
	Blue conglomerate	30	690
	Yellow clay, embedded boulders	8	698
	Red clay, embedded boulders	12	710
	Hard green conglomerate and sticky streaks	43	753
	Cemented sand and gravel to 10 inches	47	800
	TOTAL DEPTH		800

(A-2-4)33aaa

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	3	3
	Clay and caliche	12	15
	Red clay and gravel, 1½ inch, and cemented streaks	80	95
	Sandy red clay and gravel, 1 inch	170	265
Red(?) unit	Cemented granite	85	350
	TOTAL DEPTH		350

(A-2-4)35aab

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper alluvium	Fill	4	4
	Clay and caliche	11	15
Middle alluvium	Sand, gravel, and boulders	135	150
	Clay	50	200
	Clay and gravel	109	309
	Clay, sticky	241	550
	Hard clay	50	600
	Hard and sticky clay	50	650
	Hard clay and caliche	8	658
Lower(?) alluvium	Clay caliche and boulders	62	720
	Hard caliche and boulders	230	950
Red(?) unit	Conglomerate and granite boulders	35	985
	TOTAL DEPTH		985

(A-2-5)7dda

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper alluvium	Caliche, silt	60	60
Middle alluvium	Gravel and boulders	100	160
	Clay, streaks cemented sand	280	440
	Sand, streaks of clay	110	550
	Clay	50	600
	Sand, clay with boulders	148	748
	Log of Deepening		
	Sandy clay	77	825
	Gravel and clay	105	930
	Sticky clay	75	1,005
	Sandy clay	70	1,075
	Sticky clay	50	1,125
	Gravel and sand "loose"	15	1,140
	Sandy clay	80	1,220
	TOTAL DEPTH		1,220

(A-2-5)15daa

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper alluvium	Topsoil	2	2
	Clay, yellow	43	45
	Gravel and boulders	45	90
	Gravel and streaks of clay	90	180
Middle alluvium	Gravel 2 inches	4	184
	Clay yellow sand	62	246
	Gravel 2 inches	6	252
	Clay, yellow, hard	14	266
	Gravel 2 inches, tight	4	270
	Gravel 2 inches, streaks clay	44	314
	Clay, yellow, hard	18	332
	Gravel 2 inches, tight	6	338
	Clay, yellow	59	397
	Cemented gravel	17	414
	Clay, yellow	16	430
	Cemented sand	12	442
	Clay, yellow, sticky	16	458
	Cemented sand	5	463
	Clay, yellow	14	477
	Cemented sand	3	480
	Gravel 1 inch, tight	2	482
	Gravel 2 inches	16	498
	Clay, yellow	11	509
	Cemented gravel	9	518
	Clay, yellow	11	529
	Cemented sand	9	538
	Clay, yellow, sandy	31	569
	Clay, yellow	17	586
	Cemented gravel	11	597
	Log of Deepening		
	Clean out, sand, silt, air line	6	583
	Nice gravel	14	597
Lower alluvium	Conglomerate, some fairly hard, very little clay	178	775
	Little softer conglomerate, some sandy clay	35	810
	Sandy clay, but still has much gravel	20	830
	Sandy clay	4	834
	Much conglomerate with gravel	22	856
	Hard conglomerate	2	858
	Sticky clay	3	861
	Hard conglomerate	30	891
	Sticky clay	2	893
	Conglomerate	15	908
	Sticky clay	3	911
	Hard conglomerate, much gravel	41	952
	Sticky clay	2	954
	Sandy clay, still has some gravel	5	959
	Hard conglomerate with small streaks of clay, 30 percent gravel	86	1,045
	Progressively more clay, 20 percent gravel	26	1,07[illegible]
	Nice coarse conglomerate	11	1,08[illegible]
	Sticky clay	3	1,08[illegible]
	Sandy clay	2	1,08[illegible]
	Hard conglomerate	2	1,08[illegible]
	Alternating streaks of conglomerate and clay	11	1,1[illegible]
	TOTAL DEPTH		1,1[illegible]

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-2-5)16aaa		
Upper alluvium	Topsoil and caliche	62	62
	Sand, gravel, and boulders	148	210
Middle alluvium	Sandy clay	5	215
	Packed sand and gravel with some clay	45	260
	Gravel and boulders with hard ribs	30	290
	Gravel with some clay	30	320
	Sandy clay	30	350
	Cemented boulders with sandstone rib	100	450
	Sand and gravel with clay binder	20	470
	Cemented boulders and gravel	10	480
	Tough red clay	15	495
	Sand clay and gravel	5	500
	Clay with hard ribs	75	575
	Log of Deepening		
	Fill	11	496
	Clay with gravel	100	596
	Clay with pebbles	40	636
	Very sticky	1	637
	Hard conglomerate, coarse	2	639
	Softer conglomerate, loose gravel	37	676
	Sticky clay	3	679
	Hard conglomerate	4	683
	Sandy clay	5	688
	Sticky clay	3	691
	Sandy clay	6	697
	Sticky clay	7	704
Lower alluvium	Nice coarse conglomerate	17	721
	Sticky clay	2	723
	Hard coarse conglomerate	18	741
	Sticky clay	5	746
	Hard coarse conglomerate	18	764
	Sandy clay	8	772
	Hard conglomerate	13	785
	Sticky clay	6	791
	Hard conglomerate	2	793
	Gravel rolling a little	2	795
	Conglomerate	6	801
	50/50 clay and conglomerate	53	854
	Very hard	13	867
	Alternating layers of clay and conglomerate	23	890
	Hard conglomerate	34	924
	Clay	3	927
	Hard conglomerate	3	930
	Clay	3	933
	Mixed clay and conglomerate	10	943
	Hard conglomerate	3	946
	Mixed clay and conglomerate	61	1,007
	Very sticky clay	9	1,016
	Hard conglomerate	8	1,024
	Clay	3	1,027
	Hard conglomerate	7	1,034
	Clay and conglomerate	11	1,045
	Conglomerate	10	1,055
	TOTAL DEPTH		1,055
	(A-2-5)30dbc		
Upper alluvium	Topsoil	2	2
	Caliche	8	10
Middle alluvium	Gravel and boulders	123	133
	Sandy clay and gravel	142	275
	Hard clay	25	300
	Tight sand and gravel	7	307
	Hard clay	26	333
	Hard clay and gravel	15	348
	Sticky clay and gravel	57	405
	Sand	7	412
	Sticky clay and gravel	30	442
	Hard brown clay	31	473
	Caliche	5	478
	Sticky clay	50	528
	Hard clay and gravel	2	530
	Sand	6	536
	Sticky clay	29	565
	Sandstone	13	578
	Mountain formation	18	596
	Clay	4	600
	TOTAL DEPTH		600

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-3-3)6baa		
Upper(?) alluvium	Silty sands, sand, and boulders	150	150
Middle alluvium	Pea gravel	100	250
	Fine sand	50	300
	Clay	30	330
	Sand and gravel	70	400
	Sand, streaks of clay	40	440
	Sand and gravel	40	480
	Clay	20	500
Lower(?) alluvium	Sand and gravel, streaks of hard sand and gravel	380	880
	TOTAL DEPTH		880
	(A-3-3)7abd		
Upper and middle alluvium	Topsoil	17	17
	Clay and gravel	9	26
	Light-brown muddy clay	59	85
	Light-brown clay with broken rock	125	210
	Brown rock	18	228
	Dark-brown rock with shells	7	235
	Broken rock, seepage of water	5	240
	Dark-brown rock	5	245
	Light-colored rock, more water	20	265
	Clay and gravel	10	275
	Muddy clay	10	285
	Clay and gravel	5	290
	Dark broken rock and clay (water level 220 feet)	10	300
Interbedded basalt and lower alluvium undifferentiated(?)	Reddish-brown rock	10	310
	Hard dark rock	18	328
	Dark-brown rock	76	404
	Dark rock, showing of fine sand	2	406
	Hard dark rock	11	417
	Dark broken rock	40	457
	Clay with some gravel	24	481
	Dark broken rock	17	498
	Clay and broken rock	22	520
	Clay with light broken rock	15	535
	Light broken rock	15	550
	Dark broken rock	14	564
	Malpais and granite boulders	5	569
	TOTAL DEPTH		569
	(A-3-3)13add		
Upper and middle alluvium	Caliche	85	85
	Sandy clay	35	120
	Cemented sand	20	140
	Sandy clay	40	180
	Clay	125	305
Lower(?) alluvium	Cemented boulders	105	410
	TOTAL DEPTH		410

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-3-4)2baa2		
Upper and middle alluvium	Cased and cemented valley fill	218	218
	Clay and sand	798	1,016
	Coarse sand and clay	41	1,057
	Sand with gray lime and clay	96	1,153
	Sand with gray lime and clay	87	1,240
	Fine brown sand	25	1,265
	Brown sand, streaks of clay	20	1,285
	Coarse sand, streaks of clay	45	1,330
	Gray lime and hard boulders	116	1,446
	Sand and clay with little gray lime	37	1,483
	Fine gray sand	64	1,547
Lower(?) alluvium	Coarse sand with quartz shells	18	1,565
	Hard sand and rock	41	1,606
	Lime and rock	14	1,620
	Hard cemented sand and rock	46	1,666
	Sample fill, sample quartzite(?)	48	1,670
	Dolomite	20	1,686
	Showings of gray shale and hard rock	10	1,696
	Hard rock conglomerated	9	1,705
	Dolomite, gray lime	12	1,717
	Gray lime and cemented sand	16	1,733
	Dolomite, little lime	4	1,737
Red(?) unit	Conglomerate	41	1,778
	Conglomerate and streaks of white lime	12	1,790
	Conglomerate	4	1,794
	Lime salt and then shale	2	1,796
	Conglomerate	1	1,797
	Conglomerate, showing of gray lime	1	1,798
	Conglomerate, broken streaks of lime	5	1,803
	Conglomerate, shells	9	1,812
	Conglomerate, streaks of lime and shale	11	1,823
	Little sand and little gas showing in mud	2	1,825
	Conglomerate, hard shells and lime	47	1,872
	Conglomerate, little lime and shale	3	1,875
	Conglomerate, hard shells	46	1,921
	Conglomerate, lime, some shale	12	1,933
	Hard conglomerate with some lime	19	1,952
	Chert, 1 foot; conglomerate, shells, lime	11	1,963
	Conglomerate, white lime, shells	21	1,984
	Conglomerate, lime, shells	46	2,030
	Conglomerate, lime, some shale, shells	25	2,055
	Conglomerate, lime, and hard shells	22	2,077
	Conglomerate, lime, sand, hard shells	63	2,140
	Conglomerate, lime sand, shells	71½	2,211½
	Chert, 6 inches; some lime	½	2,212
	Chert; samples show some very hard red rock and quartz	1	2,213
	Conglomerate	1	2,214
	Conglomerate sand with flakes of black oily shale. This sample shows specks of oil under black lamp	4	2,218
	Conglomerate, shells, sand streaks	29	2,247
	Lime and sand	3	2,250
	Conglomerate	7	2,257
	Conglomerate, quartz, shells, lime	91	2,348
	Red bed	9	2,357
	Conglomerate, lime, hard shells	15	2,372
	Conglomerate, some red clay	13	2,385
	Conglomerate, shells, shale, lime, quartz	62	2,447
	Conglomerate with little show of red shale, shells	5	2,452
	Conglomerate, hard shells, lime, quartz	50	2,502
	Conglomerate, shells, lime	188	2,690
	Conglomerate, shells, lime, red bed	15	2,705
	(A-3-4)2baa2—Continued		
Red(?) unit—Con.	Conglomerate, shells, lime	24	2,729
	Conglomerate, lime, hard shells, streaks of red shale	34	2,763
	Conglomerate, lime, shells, bentonite	3	2,766
	Conglomerate, hard shell, bentonite lime	40	2,806
	Conglomerate, sand shells	70	2,876
	Conglomerate, lime, sand and shale	23	2,899
	Conglomerate, sand, red bed, lime	26	2,925
	Conglomerate, hard sand	6	2,931
Red unit or schist	Conglomerate, sand, lime, accnosal [sic], thin streak of red bed	24	2,955
	Conglomerate, hard shell	2	2,957
	Lime, sand, streaks of red bed	5	2,962
	Conglomerate, hard shells	44	3,006
	Conglomerate, lime, sand, shale and shells	2	3,008
	Red shale, conglomerate, sand, lime	23	3,031
	Conglomerate, sand, shale, lime	149	3,180
Schist	Shale	24	3,204
	Shale, shells	2	3,206
	Black shale, sand, shells	47	3,253
	Shale, sand, lime, streaks of red bed	30	3,283
	Green shale, streaks of bentonite, lime	68	3,351
	Hard green shale	43	3,394
	Hard green shale, shells	5	3,399
	Green shale, lime	8	3,407
	Gray shale	3	3,410
	Drill cuttings consist mainly of schist fragments below 2,931 feet.		
	TOTAL DEPTH		4,159
	(A-3-4)4cba		
Upper and middle alluvium	Brown clay with streaks of white (streamers of calcinite)	180	180
	Red sandy clay	70	250
	Water-bearing sand and gravel	10	260
	Brown clay	20	280
	Sandy clay	125	405
	Brown clay	95	500
	Sandy clay and little streamers of sand	75	575
	Sandy clay	25	600
	Clay with little sand layers	45	645
	Gravelly clay	5	650
	Sandstone	3	653
	Gravelly clay	27	680
	Sandy clay	45	725
	Very sticky gray clay	30	755
	Sandy clay	30	785
	Brown clay, very sticky	18	803
	TOTAL DEPTH		803

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

(A-3-4)17aaa

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	6	6
	Sandy gravel and clay	64	70
	Sand and gravel	10	80
	Cemented gravel, hard ribs	8	88
	Cemented gravel	12	100
	Sand and gravel with streaks clay	40	140
	Packed sand	40	180
	Sand with streaks of clay	20	200
	Sand	30	230
	Cemented sand	45	275
	Sandy clay	15	290
	Hard brown clay	30	320
	Cemented gravel	10	330
	Hard clay with ribs	20	350
	Packed sand	25	375
	Silty sand and clay	35	410
	Clay with gravel	20	430
	Sandy and clay streaked ribs	415	845
	Sandy and gravel	20	865
Lower(?) alluvium	Gravel and boulders	41	906
	TOTAL DEPTH		906

(A-3-4)21baa

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	5	5
	Clay	10	15
	Hard sand	25	40
	Clay and rock	10	50
	Clay and gravel	40	90
	Sand and gravel and streaks of clay and cemented sand	121	211
	Sand and gravel, streaks of clay	39	250
	Hard clay	11	261
	Sandy clay with streaks of gravel	129	390
	Sandy clay and streaks of coarse sand	126	516
	Clay	193	709
	Sandy clay with some gravel	91	800
Lower alluvium	Sand and gravel, hard	88	888
	Sandy clay	23	911
	Sandy clay and rock	134	1,045
	TOTAL DEPTH		1,045

(A-3-4)21ccc

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	2	2
	Caliche and embedded gravel	43	45
	Brown clay, embedded gravel 1/4 inch	54	99
	Sandy gray clay, cemented streaks	171	270
	Sandy brown clay, streaks hard clay	80	350
	Sandy brown clay, embedded gravel 1/2 inch	302	652
	Streaks sandy clay and cemented sand and gravel	26	678
Lower alluvium	Cemented sand and gravel, sticky clay streaks	30	708
	Cemented sand and gravel to 5 inches	75	783
	Sandy, gray clay, embedded granite, gravel to 5 inches	257	1,040
	Cemented sand and gravel to 5 inches	18	1,058
	Sandy gray clay, embedded granite, gravel to 5 inches	42	1,100
	TOTAL DEPTH		1,100

(A-3-4)23dad

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	10	10
	Clay and gravel	22	32
	White caliche	6	38
	Clay with gravel	87	125
	Brown clay with black sand	151	276
	Loose sand and gravel	22	298
	Red sticky clay	190	488
	Packed sand	14	502
	Clay with small sand streaks	63	565
	Tough clay	344	909
	TOTAL DEPTH		909

(A-3-4)29dcd

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Topsoil	6	6
	Clay	14	20
	Clay with hard streaks	290	310
Lower alluvium	Mountain wash (hard)	15	325
	Hard rock	9	334
	Rock	482	816
	Conglomerate (rock)	4	820
	Mountain wash	19	839
Schist(?)	Rock (broken)	33	872
	Rock	3	875
	TOTAL DEPTH		875

(A-3-4)33caa

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Clay	305	305
	Clay and gravel	3	308
	Clay	112	420
	Gravel	5	425
	Clay	85	510
	Loose gravel	12	522
	Log of Deepening		
	Clay with 1- and 2-inch gravel, rocks and traces of sand and sandstone 304 to 525	221	525
	Decomposed granite with quartz and trace of sandstone	20	545
Schist(?)	Decomposed granite, quartz and trace of sandstone	18	563
	Decomposed granite and quartz	16	579
	Decomposed granite and quartz	21	600
	TOTAL DEPTH		600

(A-3-4)34dda

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
Upper and middle alluvium	Clay, caliche	50	50
	Sand, small gravel	30	80
	Sandy clay	45	125
	Fine silt, sand, some gravel, water	35	160
	Gumbo clay	10	170
	Good sand	5	175
	Coarse sand, small gravel, few small boulders	18	193
	Heavy gumbo clay	7	200
	Sand, coarse gravel	15	215
	Heavy sticky clay	30	245
	Clay	15	260
	Sand strata	5	265
	Gray sandstone	20	285
	Heavy sticky clay	15	300
	Clay	40	340
	Sand and gravel	4	344
	Sticky clay	26	370
	Sand and gravel	5	375
	Sticky clay	128	503
Lower alluvium	Conglomerate	87	590
	Conglomerate	20	610
	Clay	56	666
	Conglomerate	25	691
	Caliche	86	777
	Layers of conglomerate	47	824
	Gravel strata	8	832
	Hard sandstone	16	848
	Sand and gravel in clay	12	860
	Sandy clay	42	902
	Sand and gravel	7	909
Schist(?)	Rock	3	912
	TOTAL DEPTH		912

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-3-4)35ada		
Upper and middle alluvium	Topsoil	5	5
	Gravel, mountain wash	3	8
	Brown clay	13	21
	Gravel in clay, mountain wash	3	24
	Hard clay and caliche	34	58
	Brown silty clay	6	64
	Sand and gravel, 1/4 inch	5	69
	Silty clay	8	77
	Sand and gravel	4	81
	Stks of clay, sandstone and gravel	3	84
	Shale rock stks caliche and clay	13	97
	Silty clay	31	128
	Shale rock	7	135
	Silty mud	14	149
	Caliche in clay	18	167
	Sand and gravel, 1/2 inch, water	2	169
	Sand and boulders, 6 inches	12	181
	Caliche in clay	11	192
	Soft sandstone and stks gravel, 1/2 inch	6	198
	Solid shale rock, very hard	2	200
	Fine sand and stks caliche	4	204
	Coarse gravel, 2 inches	2	206
	Hard brown clay	10	216
	Red sticky clay stks hard clay	48	264
	Soft sandstone and stks silty sand (some water)	13	277
	Red sticky clay stks hard clay	59	336
	Gravel in silty clay (some water)	3	339
	Brown silty clay stks hard clay	39	378
	Hard red clay	6	384
	Brown silt stks sandstone, some gravel (showing of water)	20	404
	Tough red clay	8	412
	Brown sandy clay stks sand and sandstone (some water)	10	422
	Red clay	3	425
	Brown silty clay	14	439
	Cemented sand	2	441
	Coarse sand and pea gravel (water)	25	466
	Hard red clay stks red rock	13	479
	Brown clay small veins fine sand (some water)	4	483
	Tough brown and red clay	13	496
	Hard brown clay	23	519
	Green clay stks hard rock pores (some water)	7	526
	Tough brown clay	18	544
	Solid cement and stks caliche	2	546
	Silty clay stks cement (some water)	8	554
	Tough green clay	6	560
	Pores clay (some water)	8	568
	Brown sticky clay very tough stks hard clay	49	617
	Sand and stks sandstone (some water)	6	623
	Tight fine sand	3	626
	Blue silty sand stks of clay	15	641
	Tough red sticky clay	23	664
	Blue sandstone	2	666
	Blue silty clay	8	674
	Tough brown clay stks very hard	29	703
	Stks sandstone and fine sand (water showing)	6	709
	Blue silty clay	18	727
	Fine sand, tight	4	731
	Tough red clay	10	741
	Blue silt stks cement (water showing)	7	748
	Tough red clay	6	754
	Solid cement	3	757
	Stks brown and blue clay stks hard	59	816
	Blue silt and stks cement	6	822
?			
Lower(?) alluvium	Brown clay, tough	75	897
	Brown hard silt	7	904
	Gray tight sand, fine	7	911
	Brown clay veins fine hard silt	6	917
	(A-3-4)35ada—Continued		
Lower(?) alluvium—Con.	Gray sandstone	2	919
	Hard brown clay	13	932
	Stks sandstone, red clay (water showing)	6	938
	Caliche in hard clay	9	947
	Red clay and stks red rock	53	1,000
	TOTAL DEPTH		1,000
	(A-3-5)16acc2		
Lower and middle alluvium	Loose rock	33	33
	Decomposed granite	307	340
	Hard rock (first show of water at 342 feet)	4	344
	Broken rock	16	360
	Hard rock	25	385
	Rock and thin strata of clay	30	415
	Hard rock	20	435
	Rock with thin strata of clay	8	443
	Hard rock strata	6	449
	Rock with thin strata of clay	46	495
	Rock	15	510
	Hard rock	15	525
	Decomposed granite	20	545
Schist and quartzite(?)	Very hard rock—battered drill bits	5	550
	TOTAL DEPTH		550
	(A-3-5)19adb1		
Upper and middle alluvium	Topsoil	5	5
	Clay and gravel	20	25
	Clay and gravel	160	185
	Clay and gravel	35	220
	Clay and gravel	55	275
	Sand	5	280
	Clay	10	290
	Gravel formation	5	295
	Clay	295	590
	Blue clay	5	595
	Clay	5	600
	Black clay	10	610
	TOTAL DEPTH		610
	(A-3-5)26ccd		
Upper alluvium	Caliche and gravel layers	20	20
	Conglomerate and sand layers	20	40
	Hard conglomerate	10	50
	Very hard conglomerate	15	65
Middle alluvium	Clay	45	110
	Boulders	5	115
	Clay	80	195
	Boulders, cemented	15	210
	Clay	10	220
	Clay and gravel layers	50	270
	Clay	10	280
	Boulders, cemented	15	295
	Boulders—clay, gravel binder	35	330
	Clay—sand and gravel layers	185	515
	Boulders—sand, gravel, clay	35	550
Lower alluvium	Conglomerate	95	645
	Boulders, sand-gravel, clay	65	710
	Boulders	5	715
	Conglomerate, clay and gravel layers	85	800
	TOTAL DEPTH		800

Table 2. --Modified drillers' logs of selected wells in Paradise Valley—Continued

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-4-3)26cba		
Upper alluvium	Topsoil	40	40
Middle alluvium	Hard packed gravel and clay	30	70
	Heavy sandy clay	180	250
	Tight sandy clay	26	276
	Gravel (water)	2	278
	Gravel and light clay	15	293
	Gravel water	3	296
	Gravel formation with clay	34	330
Granite(?)	Rock conglomerate	5	335
	Granite	5	340
	TOTAL DEPTH		340
	(A-4-4)10ccb		
Upper and middle alluvium	Decomposed granite wash with some clay	35	35
	Decomposed granite wash and boulders	35	70
	Decomposed granite wash and clay	20	90
	Boulders	2	92
	Streaks of clay and cemented gravel	33	125
	Clay and granite wash	50	175
	Gravel boulders and granite wash	30	205
	Sharp rock bedded in tough clay	95	300
	Sandy clay with bedded sharp rock	25	325
	Sandy clay and gravel	45	370
	Gravel	5	375
	Silt sand and clay	135	510
	Silt sand and gravel (water 580 feet, static 560)	70	580
	Coarse sand and gravel	35	615
	Sandy clay	11	626
	Tough clay	4	630
	Sharp sand with clay lenses	18	648
	Clay with sand and gravel	27	675
	Sand and gravel	15	690
	TOTAL DEPTH		690
	(A-4-4)13cbb		
Upper and middle alluvium	Surface soil	6	6
	Cemented sand gravel	223	229
	Sandy clay	177	406
	Sand water	19	425
	Sandy clay	115	540
	Sand boulder streaks	56	596
	Sand clay boulders	94	690
	Sand clay	25	715
	Sandy clay boulders	50	765
	Boulders	12	777
	Sand hard streaks boulders	48	825
	Boulders	20	845
	Cemented sand	15	860
	Sand boulders	161	1,021
	Sand clay streaks	145	1,166
	Sandy clay	64	1,230
	Clay boulders	103	1,333
Lower(?) alluvium	Cemented sand boulders	252	1,585
	TOTAL DEPTH		1,585

Stratigraphic unit	Rock description	Thickness (feet)	Depth (feet)
	(A-4-4)32bad		
Upper and middle alluvium	Topsoil	10	10
	Caliche	10	20
	Large gravel and caliche	15	35
	Clay and gravel	65	100
	Clay	75	175
	Clay and gravel	50	225
	Hard joint clay	110	335
	Sand and gravel (first water)	15	350
	Sand and gravel	25	375
	Clay and gravel (water bearing)	50	425
	Sand and gravel (water)	50	475
	Clay	25	500
	Clay and gravel	25	525
	Sand and gravel with clay streaks (water bearing)	140	665
	Hard clay	35	700
	Gravel and boulders (good water)	59	759
	Sand, gravel and clay streaks (water)	81	840
	Sand and clay (water bearing)	50	890
	Sand and gravel (good water)	30	920
	Gravel and boulders in sand (good water)	24	944
	Sand and gravel (good water)	76	1,020
	Hard clay	35	1,055
Lower(?) alluvium or bedrock(?)	Granite—hard cutting	45	1,100
	Blue granite—hard cutting	100	1,200
	Granite and hard gravel	14	1,214
	TOTAL DEPTH		1,214
	(A-5-3)14bab		
Upper alluvium	Boulders, sand clay, coarse gravel	218	218
Middle and lower alluvium	Conglomerate, with showings of caliche. Soft and hard spots	357	575
	Conglomerate, showing some blue clay. Very hard	561	1,136
	TOTAL DEPTH		1,136
	(A-5-4)7aad2		
Upper, middle, and lower alluvium	Coconino formation (volcanic surface boulders)	218	218
	Valley fill, boulders and gravel, showing some granite, quartz, slate and other metamorphic cuttings. Lots of fresh water at 250 feet	88	306
	Valley fill, blue slate, quartz and granite, some boulders in smaller size	86	392
	Valley fill, quartz, slate, granite, caliche, round smooth pebbles indicating formation not in place	483	875
	Valley fill, boulders, granite, slate, quartz, volcanics and some caliche	155	1,030
	TOTAL DEPTH		1,030
	(A-5-4)33daa		
Upper and middle alluvium	Topsoil	5	5
	Caliche	36	41
	Alluvial fill with granite wash and numerous thin strata of clay	699	740
	Fine sand and clay strata from 6 inches to 1 foot thick	161	901
	Yellow clay	67	968
	Coarse sand and gravel	6	974
	Coarse sand clay strata	19	993
	TOTAL DEPTH		993

Table 3.--Chemical analyses of water from selected wells in Paradise Valley

[Analytical results in milligrams per liter except as indicated. Dissolved-solids values represent sum of the determined constituents in solution, unless otherwise indicated. Source of data: ASHL, Arizona State Health Laboratory; ATL, Arizona Testing Laboratory; Phx, city of Phoenix; SRIA, Salt River Indian Agency; SRVWUA, Salt River Valley Water Users' Association; U of A, University of Arizona; USGS, U.S. Geological Survey]

Location	Date of collection	Depth	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Source of data
																	Calcium, magnesium	Noncarbonate			
(A-1-4)1aba	3/14/66	493	......	.....	.....	90	27	155	....	230	0	66	291	.....	11	753	335	....	1,440	......	SRVWUA
1cda	3/13/61	850	......	.....	.....	28	34	63	....	200	0	22	103	.....	5	354	207	....	705	7.8	SRVWUA
2dbb	7/ 9/65	610	......	.....	.....	56	32	148	....	168	6	66	255	.....	5	651	272	....	1,250	8.4	SRVWUA
11acd	4/12/61	545	......	.....	.....	65	43	151	....	215	0	91	277	.....	9	742	340	....	1,390	7.7	SRVWUA
	7/27/66	545	27	31	0.01	86	51	199		282	0	107	365	0.3	.....	978	425	194	1,760	7.4	USGS
11baa	5/10/65	1,050	......	.....	.06	48	26	156	....	136	0	62	260	.5	7	[1/]757	230	....	....	......	ASHL
11cda	2/15/61	581	......	.....	.....	112	50	290	....	405	0	147	418	.....	11	1,230	488	....	2,280	7.4	SRVWUA
(A-1-5)5aaa	8/ /59	....	......	.....	.....	46	35	241	5.1	122	0	298	269	.....	.....	[1/]832	260	....	1,300	......	SRIA
6bcc	8/ /59	790	......	.....	.....	36	30	161	4.7	232	0	130	174	.....	.....	[1/]627	215	....	980	......	SRIA
(A-2-4)2cc[2/]	4/24/45	405	......	.....	.....	34	32	69		230	0	35	78	.8	36	398	216	....	686	......	USGS
10cab1	5/10/65	1,396	......	.....	.....	25	17	39	....	164	0	16	18	.4	10	261	132	....	....	......	ASHL
10cab2	5/10/65	856	......	.....	.....	26	16	42	....	172	0	19	20	.7	10	272	134	....	....	......	ASHL
11ad[2/]	7/ /43	283	......	.....	.....	24	23	123		209	0	45	137	.....	10	570	....	....	....	......	SRVWUA
11cbc	7/26/66	918	31	37	.01	27	20	20		170	0	17	26	.4	.....	231	152	12	432	7.5	USGS
11dbc	5/10/65	1,300	......	.....	.20	24	17	95	....	192	4	48	72	1.0	2	[1/]422	132	....	....	......	ASHL
11dcb	5/10/65	1,372	......	.....	.....	26	21	82	....	184	2	35	82	.7	7	[1/]402	152	....	....	......	ASHL
11dcc1	7/28/66	1,003	30	34	.00	23	25	45		218	0	19	41	.5	.....	294	160	0	494	7.7	USGS
12bdd	3/14/66	1,000	......	.....	.....	9	5	157	....	194	15	29	113	.....	6	430	41	....	809	8.5	SRVWUA
12daa	3/14/66	1,200	......	.....	.....	22	12	162	....	156	0	28	210	.....	3	514	105	....	998	......	SRVWUA
13caa	7/ 9/65	1,020	......	.....	.....	18	19	80		217	0	13	65	.....	3	305	123	....	573	8.3	SRVWUA
	8/ 1/66	1,020	30	23	.....	10	8.5	159	....	166	0	26	170	1.1	.....	480	60	0	828	7.5	USGS
14cdd	7/ 9/65	960	......	.....	.....	26	15	68	....	166	8	20	68	.....	6	293	127	....	537	8.4	SRVWUA
22dcc	7/22/66	630	30	41	.00	138	112	94		212	0	375	315	.3	.....	1,180	805	632	1,980	8.1	USGS
	8/ 4/66	630	......	.....	.....	174	86	116	....	199	0	364	302	.....	62	1,200	787	....	1,930	7.7	SRVWUA
23bcc	4/12/61	780	......	.....	.....	27	20	39	....	202	0	12	30	.....	6	234	149	....	435	8.1	SRVWUA
23ddd	2/ 5/62	1,200	30	.....	.00	31	20	....	....	132	6	29	135	.5	8.4	[1/]454	162	....	....	8.2	Phx
	1/17/66	1,200	30	.....	.20	36	19	....	....	162	8	32	170	.3	12	[1/]435	170	....	....	8.1	Phx
24ba[2/]	7/ /43	161	......	.....	.....	47	21	230		311	0	88	238	.....	17	953	....	....	....	......	SRVWUA
24bad	3/23/61	1,300	......	.....	.....	31	22	118	....	134	17	25	175	.....	3	457	170	....	895	8.6	SRVWUA
	7/29/66	1,300	29	23	.02	29	26	153		130	0	37	260	.7	.....	593	180	74	1,090	7.5	USGS
25aa1[2/]	8/12/43	300	......	.....	.....	68	30	201		266	0	110	280	.....	.....	955	....	....	....	......	U of A
25aa2[2/]	8/12/43	800	......	.....	.....	60	34	254		332	0	130	306	.....	.....	1,120	289	....	....	......	U of A

See footnotes at end of table.

Table 3.--Chemical analyses of water from selected wells in Paradise Valley—Continued

Location	Date of collection	Depth	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Source of data
																	Calcium, magnesium	Noncarbonate			
(A-2-4)25aaa	7/13/58	1,200	34	......	.....	23	14	....	....	142	......	51	105	0.7	20	[1]441	114	....	....	8.1	Phx
	1/17/66	1,200	32	......	0.35	28	15	....	....	132	4	32	215	.3	3.2	[1]482	132	....	....	7.9	Phx
25aab	/ /64	1,325	28	......	.04	42	23	....	....	100	6	57	260	.3	6.3	[1]716	200	....	....	8.0	U of A
	1/17/66	1,325	32	......	.20	35	20	....	....	170	8	29	185	.3	6.7	[1]452	172	....	....	8.0	U of A
25abb	/ /64	1,200	32	......	.01	25	136	....	....	162	8	23	64	.3	6.5	[1]333	136	....	....	8.0	U of A
	1/17/66	1,200	33	......	.20	24	19	....	....	198	8	16	95	.3	8	[1]317	138	....	....	8.0	U of A
25bcd	6/13/61	1,295	......	......	.....	44	29	123	....	129	14	47	218	......	6	545	229	....	1,060	8.3	SRVWUA
	7/15/66	1,295	26	34	.....	50	32	158		148	0	60	295	.7	.....	703	258	137	1,270	8.2	USGS
25cdd	12/11/62	1,200	30	......	.00	22	17	....	....	128	4	17	80	.5	4.5	[1]383	126	....	....	8.4	Phx
	1/31/66	1,200	28	......	.00	34	17	....	....	90	8	47	300	.3	8.8	[1]624	158	....	....	8.0	Phx
25dca	2/24/62	1,205	32	......	.00	26	22	....	....	160	8	23	120	.4	6.1	[1]434	156	....	....	7.8	Phx
	1/25/66	1,205	32	......	.....	38	16	....	....	168	2	29	170	.3	8.5	[1]443	160	....	....	7.9	Phx
35aab	/ /64	985	31	......	.05	55	46	....	....	132	10	68	200	.3	14	[1]739	326	....	....	7.9	Phx
	1/25/66	985	31	......	.00	86	30	....	....	166	8	114	225	.3	15	[1]805	340	....	....	7.7	Phx
35abb	/ /64	1,000	27	......	.03	56	46	....	....	150	8	82	170	.3	15	[1]748	330	....	....	7.9	Phx
35b[2]	7/ /43	250	......	......	.....	122	70	345		462	0	365	376	......	62	1,800	....	....	....	......	SRVWUA
35bba	5/24/58	250	......	......	.....	130	71	274	....	414	0	271	387	......	37	1,370	617	....	2,370	7.6	SRVWUA
35dcc	7/ 9/65	660	......	......	.....	75	52	152	....	213	12	115	285	......	9	805	401	....	1,480	8.5	SRVWUA
	7/22/66	660	24	30	.08	58	55	150		242	0	112	270	.6	.....	795	370	172	1,410	7.4	USGS
(A-2-5)6acb	8/26/66	500	29	24	.06	7.2	3.2	118		188	0	23	76	.8	.....	345	31	0	578	8.1	USGS
15aaa	8/ /59	658	......	......	.....	36	42	241	6.2	171	......	317	234	......	.....	[1]857	265	....	1,340	......	SRIA
16aaa	8/ /59	575	......	......	.....	56	57	230	5.1	189	......	293	299	......	.....	[1]960	375	....	1,500	......	SRIA
19aba	8/ /59	1,106	......	......	.....	34	19	207	3.9	128	......	216	206	......	.....	[1]640	165	....	1,000	......	SRIA
	7/21/66	1,106	31	30	.02	27	22	167		124	0	40	268	1.1	.....	616	160	58	1,090	7.3	USGS
(A-3-3)2bc[2]	4/24/46	250	......	......	.....	24	16	26		184	0	11	7	.4	10	185	126	....	330	......	USGS
3ab[2]	4/24/46	297	......	......	.....	28	19	29		188	0	29	16	.4	5.8	220	148	....	385	......	USGS
13bdb2	9/ 1/66	405	31	......	.23	34	13	....	....	268	8	66	62	1.0	10	[1]310	140	....	....	7.9	Phx
(A-3-4)6ccd	1/11/66	1,140	......	......	.00	21	19	....	....	160	0	0	55	.4	7	[1]216	130	....	....	7.7	Phx
21baa	8/ 4/66	1,045	33	35	.01	20	29	37		246	0	11	25	.5	.....	278	168	0	450	7.4	USGS
21ccb	11/22/63	1,050	......	......	.....	21	20	29	....	178	4	6	9	.4	8	[1]231	136	....	....	......	ASHL
22aca	3/ 4/65	1,200	......	......	.....	5	3	67	....	142	0	7	9	.6	5	[1]186	24	....	305	......	ASHL
23acd	3/ 4/65	600	......	......	.06	14	13	47	....	164	4	8	8	.6	4	[1]216	88	....	345	......	ASHL
23bcd	11/22/63	580	......	......	.....	5	4	60	....	140	0	4	9	.4	6	[1]180	24	....	....	......	ASHL
24a[2]	4/24/45	365	......	......	.....	20	18	49		232	0	14	10	1.2	9.6	236	124	....	400	......	USGS

See footnotes at end of table.

Table 3. --Chemical analyses of water from selected wells in Paradise Valley—Continued

Location	Date of collection	Depth	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Source of data
(A-3-4)24caa	5/19/65	700	......	......	0.20	18	14	53	....	182	0	7	12	1.1	4	[1/]251	104	....	....	.....	USGS
27bba	11/22/63	980	......	......	.....	14	11	45	....	160	8	6	10	.5	6	[1/]198	78	....	....	.....	USGS
27ddd	7/ 9/65	300	......	......	.....	20	21	30	....	180	2	7	8	.5	6	[1/]222	136	....	400	.....	USGS
29dcd	11/22/63	875	......	......	.....	23	18	40	....	172	4	14	16	.5	10	[1/]263	132	....	....	.....	USGS
34ada	7/ 9/65	400	......	......	.....	16	16	50	....	164	0	8	19	.5	16	[1/]264	108	....	417	.....	USGS
(A-3-5)19adb2	8/31/66	1,158	30	39	.01	28	18	63		242	0	12	48	.9	.....	328	144	0	516	7.5	USGS
26ccd	5/20/66	800	......	30	.00	132	15	136	....	337	0	140	186	.4	.....	[1/]977	392	....	....	7.5	ATL
(A-4-3)26cba	12/ 4/64	340	......	......	.....	45	12	57	....	140	0	30	79	1.2	11	[1/]367	164	....	....	.....	ASHL
27db[2/]	4/24/46	152	......	......	.....	127	62	124		349	0	325	140	3.0	15	968	572	....	1,510	.....	USGS
35cc[2/]	4/24/46	203	......	......	.....	112	61	73		97	0	309	145	1.4	100	849	530	....	1,330	.....	USGS
(A-4-4)10ccb	5/13/65	690	......	......	.50	36	14	25	....	156	4	12	25	.5	1	[1/]235	148	....	....	.....	USGS
29aa[2/]	4/25/46	355	......	......	.....	....	....	......	....	268	0	......	12	.....	.....	....	....	....	436	.....	USGS
30cb[2/]	4/25/46	300	......	......	.....	18	23	29		213	0	8.2	9	.4	6.4	199	140	....	366	.....	USGS
(A-5-4)1c[2/]	6/ 4/46	277	......	......	.....	34	4.9	75		287	0	9.1	9	3.2	3.2	280	105	....	485	.....	USGS
3c[2/]	6/ 4/46	142	......	......	.....	102	30	42		441	0	31	44	2.2	10	478	378	....	831	.....	USGS
5dcc	3/ /66	870	......	24	.00	82	1	78	....	327	0	35	52	.8	.....	[1/]600	204	6	....	.....	ATL
	4/28/66	870	......	......	.90	42	23	60	....	256	0	17	35	.8	4	[1/]390	200	....	588	.....	ASHL
7a[2/]	6/ 5/46	972	......	......	.....	49	23	54		321	0	26	27	1.0	3.9	342	217	....	600	.....	USGS
8dbd	12/31/65	1,100	......	......	.70	54	30	53	....	264	0	23	35	.7	4	[1/]400	260	....	625	.....	ASHL
33daa	5/14/65	993	......	......	.....	61	16	50	....	252	4	13	40	.4	2	[1/]383	220	....	625	.....	ASHL

[1/]Residue on evaporation.

[2/]Data taken from McDonald and others (1947). Record of well not necessarily shown in table 2 of this report.

Table 4.--Field determinations of temperature and specific conductance of water from selected wells, summers of 1965 and 1966, in Paradise Valley

[Source of data: USBR, U.S. Bureau of Reclamation; USGS, U.S. Geological Survey]

Location	Date of collection	Temperature (° C)	Specific conductance (micromhos at 25° C)	Source of data
(A-1-4)1aba	7/15/65	27	1,380	USBR
1cda	9/ 2/66	32	670	USGS
1dab	7/15/65	34	675	USBR
2dbb	7/15/65	28	1,300	USBR
11baa	7/15/65	36	1,250	USBR
11cda	7/15/65	29	1,720	USBR
15cdd[a/]	7/15/65	28	2,000	USBR
23dba[a/]	7/16/65	26	2,050	USBR
27aaa[a/]	7/15/65	26	2,150	USBR
31aad[a/]	7/15/65	23	2,650	USBR
35abb[a/]	7/15/65	27	2,000	USBR
(A-1-5)1add[a/]	7/14/65	23	1,200	USBR
1bda[a/]	7/14/65	22	925	USBR
2aaa[a/]	7/14/65	23	1,100	USBR
2bbb[a/]	7/14/65	22	1,300	USBR
2cbb[a/]	7/14/65	22	1,300	USBR
2dbb[a/]	7/14/65	22	1,220	USBR
2dcc[a/]	7/14/65	22	1,350	USBR
2ddc[a/]	7/14/65	22	1,220	USBR
3ddc[a/]	7/14/65	22	1,320	USBR
4ddd[a/]	7/14/65	22	1,300	USBR
9dcd[a/]	7/14/65	26	1,220	USBR
10ccc[a/]	7/14/65	24	1,250	USBR
11cbd[a/]	7/15/65	22	1,520	USBR
13bbc[a/]	7/15/65	22	1,700	USBR
13dbb[a/]	7/15/65	22	1,850	USBR
14bcc[a/]	7/15/65	23	1,400	USBR
14cdd[a/]	7/15/65	24	1,280	USBR
17dbb[a/]	7/14/65	24	1,280	USBR
18ddd[a/]	7/14/65	23	1,320	USBR
19acc[a/]	7/14/65	23	1,900	USBR
21abb[a/]	7/15/65	26	1,200	USBR
22ccd[a/]	7/15/65	24	1,220	USBR
22ddd[a/]	7/15/65	23	1,450	USBR
24aad[a/]	7/15/65	23	1,900	USBR
26ddd[a/]	7/14/65	23	2,400	USBR
27b[a/]	7/15/65	27	1,200	USBR
30bba[a/]	7/14/65	26	1,400	USBR
30dbb[a/]	7/14/65	24	1,450	USBR
31dcc[a/]	7/14/65	28	1,250	USBR
32ccc[a/]	7/14/65	22	2,100	USBR

Location	Date of collection	Temperature (° C)	Specific conductance (micromhos at 25° C)	Source of data
(A-1-5)33cdd[a/]	7/14/65	25	2,020	USBR
34ddd[a/]	7/13/65	23	2,350	USBR
35baa[a/]	7/14/65	23	1,720	USBR
(A-2-4)11cbc	7/ 8/65	32	490	USBR
11dcc	7/ 8/65	32	480	USBR
12bbc	7/ 8/65	33	510	USBR
12bdd	7/ 8/65	36	500	USBR
14acb	9/ 9/66	....	800	USGS
22dcc	7/ 8/65	28	2,150	USBR
35bba	7/ 8/65	25	1,700	USBR
35dcc	7/ 8/65	25	1,580	USBR
(A-2-5)6acb	8/ 1/66	30	550	USGS
	8/22/66	29	560	USGS
7dda	7/ 8/65	29	1,180	USBR
15aaa	9/ 9/66	26	1,200	USGS
16aaa	7/ 8/65	27	1,550	USBR
	7/26/66	26	1,850	USGS
16caa	9/ 9/66	22	1,350	USGS
(A-3-3)3aca2	9/21/66	....	400	USGS
(A-3-4)6dcc	9/15/66	....	380	USGS
9ccc	9/15/66	....	400	USGS
14baa	9/15/66	....	390	USGS
15add	9/16/66	....	375	USGS
17baa	7/ 9/65	32	380	USBR
21baa	7/ 9/65	34	400	USBR
23bcd	9/14/66	....	280	USGS
24bcd	8/15/66	27	390	USGS
26aad	9/16/66	....	410	USGS
27bba	9/14/66	....	400	USGS
27ccd	9/16/66	....	430	USGS
(A-3-5)16acc2	8/23/66	....	540	USGS
18ccc	8/22/66	....	480	USGS
20bbb1	8/22/66	....	540	USGS
20bbb2	8/22/66	....	450	USGS
25cab	8/23/66	....	380	USGS
27bba	8/23/66	....	356	USGS
28acd	8/23/66	....	550	USGS
(A-4-3)23cab	7/ 7/65	38	400	USBR
26cba	7/ 9/65	32	610	USBR
	9/21/66	....	570	USGS
26dba	9/21/66	....	340	USGS
35daa2	7/ 9/65	33	400	USBR

See footnote at end of table.

Table 4.--Field determinations of temperature and specific conductance of water from selected wells, summers of 1965 and 1966, in Paradise Valley—Continued

Location	Date of collection	Temperature (°C)	Specific conductance (micromhos at 25°C)	Source of data
(A-4-4)13aab2	7/ 7/65	36	550	USBR
	9/16/66	....	540	USGS
17ccc	9/14/66	....	380	USGS
30cbb	9/19/66	....	320	USGS
31ccd	7/ 9/65	33	400	USBR
	9/19/66	....	330	USGS
(A-4-4)32cda	9/16/66	....	370	USGS
(A-5-4)3dcd	7/ 7/65	42	700	USBR
7aad	7/ 7/65	32	600	USBR
	9/22/66	....	540	USGS
33daa	7/ 7/65	40	610	USBR

a/ Outside project area.

Table 5.--Specific capacities and yield factors for selected wells in Paradise Valley

[Remarks: R, reported by driller; S, data from Salt River Valley Water Users' Association]

Location	Depth of well (feet)	Date tested (month, year)	Discharge (gallons per minute)	Specific capacity (gallons per minute per foot of drawdown)	Geohydrologic data		Yield factor	Remarks
					Water-bearing unit	Saturated thickness (feet)		
(A-1-4)1aba	493	12/45	2,613	39	Upper alluvium Middle alluvium Red(?) unit	58 387 3	8.7	S. No. 1 in figure 9.
	493	3/66	693	5	Upper alluvium Middle alluvium Red(?) unit	0 286 3	1.7	Do.
1cd	145	12/45	2,555	31	Upper alluvium Middle alluvium	73 29	30	R. Not shown in table 1; destroyed. No. 2 in figure 9.
1cda	850	7/52	3,580	67	Upper alluvium Middle alluvium Lower alluvium Red unit	56 634 93 7	8.5	S. No. 2a in figure 9.
2dbb	610	11/48	3,700	103	Upper alluvium Middle alluvium Red unit	94 366 90	19	R. No. 3 in figure 9.
	610	10/65	1,178	18	Upper alluvium Middle alluvium Red unit	0 285 90	4.8	S. No. 3 in figure 9.
2dcc	151	5/45	3,376	52	Upper alluvium Middle alluvium	100 18	44	R. No. 4 in figure 9.
11acd	545	4/49	3,076	32	Upper alluvium Middle alluvium Red(?) unit	96 338 73	6.3	R. No. 5 in figure 9.
11cda	581	9/53	2,795	30	Upper alluvium Middle alluvium Red(?) unit	91 420 27	5.6	R. No. 6 in figure 9.
11dcb	225	12/45	3,224	43	Upper alluvium Middle alluvium	104 98	21	R. Not shown in table 1; destroyed. No. 7 in figure 9.
(A-2-4)11dc	482	12/45	961	21	Upper alluvium Middle alluvium	25 358	5.5	R. Not shown in table 1; destroyed. No. 8 in figure 9.
11dcc1	1,003	3/57	3,218	96	Upper alluvium Middle alluvium Lower alluvium	0 551 238	12	S. No. 8a in figure 9.
12aad	700	3/65	450	9	Upper alluvium Middle alluvium	0 525	1.7	R. No. 9 in figure 9.
12bb	283	12/45	498	6	Upper alluvium Middle alluvium	2 181	7.2	S. Not shown in table 1; destroyed. No. 10 in figure 9.
12bdd	1,000	3/57	2,936	52	Upper alluvium Middle alluvium Lower(?) alluvium	0 690 106	6.5	S. No. 11 in figure 9.
	1,000	8/64	2,450	40	Upper alluvium Middle alluvium Lower(?) alluvium	0 539 106	6.2	Aquifer test, 6 hours; T = 180,000. No. 11 in figure 9.
12daa	544	5/49	1,000	15	Upper alluvium Middle alluvium	29 398	3.5	R. Test made before deepening. No. 12 in figure 9.
	1,200	7/53	950	14	Upper alluvium Middle alluvium	12 1,054	1.3	R. Test made after deepening. No. 12 in figure 9.
12ddd	1,481	6/65	2,000	34	Upper alluvium Middle alluvium Lower alluvium	0 558 581	3.0	R. No. 13 in figure 9.
13caa	1,020	4/52	2,430	35	Upper alluvium Middle alluvium Lower alluvium	6 715 203	3.8	R. Well casing is perforated mostly in the lower alluvium; yield factor is 17 if only this thickness is considered. Graphs (fig. 9) show both versions. No. 14 in figure 9.
	1,020	8/66	2,160	28	Upper alluvium Middle alluvium Lower alluvium	0 512 203	3.9	See above; yield factor is 14. Aquifer test, $4\frac{1}{2}$ hours; T = 160,000. No. 14 in figure 9.

Table 5. --Specific capacities and yield factors for selected wells in Paradise Valley—Continued

Location	Depth of well (feet)	Date tested (month, year)	Discharge (gallons per minute)	Specific capacity (gallons per minute per foot of drawdown)	Geohydrologic data		Yield factor	Remarks
					Water-bearing unit	Saturated thickness (feet)		
(A-2-4)14acb	726	10/60	900	8	Upper alluvium Middle alluvium Granite(?)	0 400 26	2.0	R. No. 15 in figure 9.
14cbb	207	5/46	1,250	31	Upper alluvium Middle alluvium	80 7	36	R. Test made before deepening. No. 16 in figure 9.
15dda	202	/46	1,500	33	Upper alluvium Middle alluvium	78 4	40	R. Not shown in table 1; destroyed. Not shown in figure 9.
22aab	204	/46	1,650	37	Upper alluvium Middle(?) alluvium	84 4	44	R. Not shown in table 1; destroyed. No. 17 in figure 9.
22da	256	3/44	1,000	40	Upper alluvium Middle alluvium	85 76	25	R. Not shown in table 1; replaced. No. 18 in figure 9.
22dcc	630	7/66	1,555	39	Upper alluvium Middle alluvium Red(?) unit	0 264 30	13	Aquifer test, 3½ hours; T = 130,000. No. 19 in figure 9.
23bbb	202	3/46	800	20	Upper alluvium	82	24	R. Not shown in table 1; destroyed. No. 20 in figure 9.
23ddd	1,200	5/59	1,510	66	Upper alluvium Middle alluvium Red(?) unit	37 575 450	6.2	R. No. 21 in figure 9.
24bad	490	1/49	1,500	43	Upper alluvium Middle alluvium	55 345	11	R. Test made before deepening. No. 22 in figure 9.
	1,300	8/53	2,950	66	Upper alluvium Middle and middle(?) alluvium Lower alluvium and red(?) unit	27 490 665	5.6	R. Test made immediately after deepening. No. 22 in figure 9.
	1,300	7/66	2,190	37	Upper alluvium Middle and middle(?) alluvium Lower alluvium and red(?) unit	0 338 665	3.7	Aquifer test, 4 hours; T = 96,000. No. 22 in figure 9.
25aaa	1,200	4/58	1,400	40	Upper alluvium Middle alluvium Lower alluvium Red(?) unit	0 347 530 130	4.0	R. No. 23 in figure 9.
25aab	1,325	3/65	1,550	44	Upper alluvium Middle alluvium Lower alluvium Red(?) unit	0 253 600 185	4.2	R. No. 24 in figure 9.
25bcd	550	9/49	1,580	26	Upper alluvium Middle alluvium	75 390	5.6	R. Test made before deepening. No. 25 in figure 9.
	1,295	7/66	1,555	30	Upper alluvium Middle alluvium Red(?) unit	0 452 535	3.0	Aquifer test, 55 hours; T = 130,000. No. 25 in figure 9.
25cd	197	12/45	4,113	49	Upper alluvium Middle alluvium	96 39	36	R. Not shown in table 1; abandoned. No. 26 in figure 9.
25cdd	500	5/50	2,500	43	Upper alluvium Middle alluvium	66 354	10	R. Test made before deepening. No. 26a in figure 9.
	1,200	5/60	3,650	99	Upper alluvium Middle alluvium Lower(?) alluvium Red unit	0 554 350 55	10	R. Test made after deepening. No. 26a in figure 9.
25dca	500	4/50	2,285	28	Upper alluvium Middle alluvium	63 360	6.6	R. Test made before deepening. No. 27 in figure 9.
	1,205	4/58	1,565	71	Upper alluvium Middle alluvium Lower(?) alluvium	0 548 500	6.8	R. Test made after deepening. No. 27 in figure 9.

Table 5.--Specific capacities and yield factors for selected wells in Paradise Valley—Continued

Location	Depth of well (feet)	Date tested (month, year)	Discharge (gallons per minute)	Specific capacity (gallons per minute per foot of drawdown)	Geohydrologic data		Yield factor	Remarks
					Water-bearing unit	Saturated thickness (feet)		
(A-2-4)35aab	985	5/58	1,400	58	Upper alluvium Middle alluvium Lower(?) alluvium Red(?) unit	10 508 292 35	6.9	R. No. 28 in figure 9.
35dcc	660	7/66	1,800	37	Upper alluvium Middle alluvium Lower(?) alluvium	0 323 80	9.2	No. 29 in figure 9.
(A-2-5)16aaa	1,055	9/63	2,800	97	Upper alluvium Middle alluvium Lower alluvium	0 447 351	12	R. No. 30 in figure 9.
(A-3-3)13bdb2	330	4/60	190	4	Upper and middle alluvium undifferentiated Lower(?) alluvium	74 10	5.3	R. Test made before deepening.
	405	1/66	460	13	Upper and middle alluvium undifferentiated Lower(?) alluvium	64 85	8.7	R. Test made after deepening.
(A-3-4)2baa1	1,585	6/50	1,200	10	Upper and middle alluvium undifferentiated Lower(?) alluvium	1,132 153	.8	R.
11cba	1,200	1/56	480	3	Upper and middle alluvium undifferentiated Lower alluvium	798 180	.3	R.
12cda	500	7/53	400	8	Upper and middle alluvium undifferentiated	250	3.2	R.
21aba	820	7/53	500	6	Upper and middle alluvium undifferentiated	660	.9	R.
21baa	1,045	2/57	1,890	29	Upper and middle alluvium undifferentiated Lower alluvium	638 225	3.4	R.
	1,045	8/66	1,227	31	Upper and middle alluvium undifferentiated Lower alluvium	488 225	4.3	
23dad	909	7/63	650	4	Upper and middle alluvium undifferentiated	699	.6	R.
24bcd	890	2/54	600	4	Upper and middle alluvium undifferentiated	685	.6	R.
24bdb	715	4/51	800	14	Upper and middle alluvium undifferentiated	520	2.7	R.
29aaa	894	8/49	650	16	Upper and middle alluvium undifferentiated Lower alluvium	503 254	2.1	R.
33daa	865	1/66	1,500	24	Upper and middle alluvium undifferentiated Schist	365 229	4.0	R.
34daa	300	1/52	250	3	Upper and middle alluvium undifferentiated	181	1.7	R.
34dba	300	11/51	510	11	Upper and middle alluvium undifferentiated	160	6.9	R.
	885	3/54	500	6	Upper and middle alluvium undifferentiated Lower alluvium Schist(?)	652 85 20	.8	R; well abandoned.
34dda	300	11/51	500	14	Upper and middle alluvium undifferentiated	172	8.1	R.
	912	7/54	500	6	Upper and middle alluvium undifferentiated Lower alluvium Schist(?)	364 406 3	.8	R; well abandoned.
35bac	400	7/54	450	4	Upper and middle alluvium undifferentiated	232	1.7	R.

Table 5.--Specific capacities and yield factors for selected wells in Paradise Valley—Continued

Location	Depth of well (feet)	Date tested (month, year)	Discharge (gallons per minute)	Specific capacity (gallons per minute per foot of drawdown)	Geohydrologic data		Yield factor	Remarks
					Water-bearing unit	Saturated thickness (feet)		
(A-3-5)26ccd	800	5/66	240	2	Upper alluvium	0	0.4	R.
					Middle alluvium	198		
					Lower alluvium	250		
(A-4-4)32bad	1,214	8/52	1,500	12	Upper and middle alluvium undifferentiated	795	1.3	R.
					Lower(?) alluvium or bedrock(?)	159		
32cda	1,331	6/52	1,500	12	Upper and middle alluvium undifferentiated	948	1.1	R.
					Lower alluvium	131		

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